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THE DESIGN AND EQUIPMENT OF HOSPITALS

THE

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HOSPITALS

RONALD WARD

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MEDICAL FOREWORD

by SIR W. ALLEN DALEY, M.D., F.R.C.P., D.P.H., K.H.P.

Medical Officer of Health to the London County Council

Mr. Ronald Ward's book on the design and equipment of hospitals is sure of a warm welcome from all who are interested in the construction or management of institutions for the care of the sick. A comprehensive textbook on this subject is a long-felt want. The size of the book and perusal of its table of contents indicate the magnitude and complexity of his task.

The "general hospital", familiar to most people, is only one of a large variety of hospitals. Each type of hospital has problems and needs peculiar to itself, and Mr. Ward has given close attention to all their different requirements. But every hospital—general or special—has its basic needs—accommodation for patients and staff, a kitchen and administrative provision. Most hospitals have many other departments, e.g. operating, radio-diagnostic, physiotherapy, a pathological laboratory, out-patients accommodation and a laundry. Some hospitals contain the population of a village and a wide range of services must be provided.

Mr. Ward has rightly put in the forefront of his hospital planning the functions which each particular unit has to perform. The efficiency of a hospital depends on its being designed to fulfil its functions smoothly and with the minimum of labour, i.e. on its internal planning rather than its external appearance, though there is no inherent reason why the latter should be displeasing. Mr. Ward has studied with meticulous care the thousand and one details which the experience of patients, doctors, nurses, domestic workers, hospital engineers and administrators has shown to be necessary. There is room for disagreement in some cases as to what is the best solution of some of the problems. Mr. Ward has expressed his own views, derived from many years' work in this special field. I commend this book as an extremely valuable contribution to a matter of vital importance, namely the provision of the best possible buildings in which hospital staff can attend to the sick and the suffering who solicit their aid.

ADMINISTRATIVE FOREWORD

By J. P. WETENHALL, B.A.

Director of the Central Bureau of Hospital Information
and Secretary of the British Hospitals Association

Mr. Ronald Ward's book on the design and equipment of hospitals meets a present need and will be of practical use to all interested in the subject. The virtual cessation of hospital renovation and construction during the war, followed by the responsibility now statutorily imposed on the State to provide a National Health Service, including adequate hospital accommodation, brings to the forefront the importance of hospital design and construction.

Mr. Ward is right when he places the patient at the top of his list of interests to be considered in hospital planning and construction. The functional, as apart from the architectural, design directly affects the interests, including the comfort, of both patients and staff. It is therefore essential in any plan for hospital building to bring together in continuous consultation the heads of all the departments of the hospital, medical, technical, nursing and domestic—with the administrator acting as liaison between them to ensure the best possible results. All the members of that committee should have in their minds, as well as their own particular interest, the general interests of the patients. In this way important items, such as the elimination of noise, will no longer be overlooked.

Ideally, every hospital building should be a shell that can change and grow as the living organism in it changes and grows. There is no final static point in the practice of medicine ; equally there is no ultimate perfection in hospital design, or limitation in the requirements which hospitals may be called upon to meet from time to time.

Much of what Mr. Ward has written is related to practice in the former local authority, rather than voluntary, hospitals especially as regards administration ; and he covers his subject in great detail, some of which will provoke discussion and argument. It is, however, important that a hospital should have its own entity and that there should be no attempt at mass production. Nevertheless, by so thorough a review of the standards of hospital planning and construction, the Author has made a very valuable and detailed contribution to the study of a subject of great importance.

ARCHITECTURAL FOREWORD

by FREDK. R. HIORNS, F.S.A., F.R.I.B.A., Dist'n.T.P.

Sometime Architect to the London County Council

Despite a vast pre-war output of the literature relating to building and public health, an up-to-date and systematically arranged collection of essential data bearing upon the planning, general design and fixed equipment of hospitals and their accessory buildings is difficult to obtain in this country.

It is accordingly appropriate that Mr. Ronald Ward, with a background of special training and interest in the subject, should at this stage set out to fill an obvious gap in medical and architectural literature ; the meeting of a need that post-war activities for the public welfare have put in demand. In the planned form of physical development and reconstruction to which we are enjoined to look forward, means for healthy living must take a primary place ; and the curative treatment of physical and mental sickness is a vital factor in progressive improvement of the means of living. A book such as that now before us is clearly a necessary accessory in that process.

The collection and marshalling together of so much valuable information—embodying varied and specialised technique in compact form—is an achievement well reflecting the active mind and organising capacity of the author of this work. Opinions may vary, as they always have, on many points, preferences or suggestions that Mr. Ward puts forward on a subject on which medical and other authorities are prone to differ. But even a brief look at the text and illustrations shows the value of such a store-house of selective precedent and data to both the health practitioner and his architectural and engineering coadjutors.

In a still wider aspect will come the question of the relation of health treatment to general hygienic conditions (that still remain unsatisfactory) and to town-planning. With this is bound up the ultimate aim of reducing the need for vast institutions for treatment of disease and physical ills generally that—by a more correct arrangement of towns and healthier means for living—must be largely avoidable. Meanwhile, many of those engaged in the mitigation of human suffering will be grateful for a work offering constructive guidance in one very important aspect of that benevolent purpose ; and certainly so as regards the architectural profession, for whom this book is especially intended.

PREFACE

What kind of world will there be in 1960? Nobody knows, nobody can tell. Being an optimist, I have faith in progress, for two reasons. The first is, that social upheavals, if they are not big enough to overwhelm, lead people and nations to venture on social and welfare experiments of far-reaching character—witness the results of the Beveridge Report of 1943! The second reason is that the twentieth century has shown mankind everywhere willing, and usually able, to make quick changes without parallel in the past. The idea of planning social life on the basis of scientific thinking holds out possibilities of changes which, sooner or later, are going to affect most things, including hospitals. Looking backwards on medical science of the past, one notes the inherent conservatism of the hospital tradition. Hospital ways change slowly at the best, and even revolutions are apt to pass them by and leave them carrying on much as they always have done. Whatever changes in hospital organisation are forthcoming in our immediate future are coming slowly, even if other social changes come quickly.

Assuming that mankind weathers the storm of crises by processes of adjustment beyond present calculation, it is obvious that changes in the design of hospitals—which were being considered in the pre-1939–45 war days—will again merit consideration. The art of the prophet lies in discerning the direction of such changes and estimating their extent.

This is the object of this book—to assist doctors, hospital administrators, public health officials and architects in the future design and construction of these health-giving institutions.

London,
March 1949.

ACKNOWLEDGEMENTS

The Author is most grateful and wishes to place on record his indebtedness to those medical men who have helped in the preparation of this book, and to those officials, architects and editors of technical journals who have generously allowed photographs, plans and illustrations, together with MSS., to be re-produced.

His sincerest thanks are due to Sir W. Allen Daley, Medical Officer of Health to the London County Council; to Mr. J. P. Wetenhall, Secretary to the British Hospitals Association, Director of the Central Bureau of Hospital Information, and to Mr. Fredk. R. Hiorns, sometime Architect to the London County Council, for reading through the manuscripts, and for their suggestions and corrections.

PHOTOGRAPHS AND DIAGRAMS

The various photographs, together with the plans and other diagrams herein, are intended to illustrate in a general way the more essential requirements, relative to one another, of the various units or departments of a hospital, and their equipment.

Each case in practical application would be subject to variation as necessary to suit local circumstances, and would embody accommodation requirements and special features considered desirable by those concerned. In this sense, and having regard to the progressive nature of both medical practice and building technique, it must be apparent that the laying down of absolute standards is neither possible nor desirable.

The Author's choice of photographs has been limited, due to printers' blocks having been surrendered to assist the war effort, to the large number of blocks and photographs destroyed by enemy action, and to the restriction in production. He wishes to acknowledge his appreciation to those who offered to lend photographs, and to the following for the loan thereof: Messrs. T. & R. Annan & Sons; Sir John Brown, A. E. Henson & Partners; Sir John Burnet, Tait & Lorne; Cecil Burns, Esq.; Messrs. Easton & Robertson; F. Gibberd, Esq.; A. W. Hall, Esq.; P. J. B. Harland, Esq.; The Royal Melbourne Hospital; C. G. Stillman, Esq.; Eric W. Vincent, Esq.; Messrs. H. J. Whitlock & Sons, Ltd.

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INTRODUCTION

IMPOVERISHED as we are by the awful sacrifice of men and materials that the war involved, we are now faced with the necessity of undertaking a vast amount of reconstruction of hospital buildings. In spite of all the misery we have gone through—largely, indeed, because of it—there is now a great eagerness to make a new beginning. In the past, many schemes were too feeble and unconsidered, the objectives too hazy and vague. As a result, in the great rush of activity the plans never even began to work, and we got only muddle and mess with the subsequent disillusionment. It will be infinitely tragic if this happens—and it will, unless we get the basis of our future planning policy firmly settled now; unless we have our minds crystal clear as to what we have to aim at and how we can best achieve it.

The complexity of the problem makes it necessary for hospital architects to keep in close touch with rapid developments in modern surgical methods and to have a thorough knowledge of hospital administration. I am convinced that nothing will help more to improve the design and management of these important institutions than a close collaboration between doctor and architect. I would say that no really first-class hospital could be designed without an intimate knowledge on the part of the designers of every small process of medical and surgical routine and of the administrative side of the hospital. For the most part, architects look to medical scientists to suggest the ideals to be arrived at; it is for the architects and engineers then to show how these ideals may be carried out. To-day, when conditions are so rapidly changing and problems are mostly without precedent, the designers' task is far more complicated than in the past, for to obtain the ideal solution for any hospital they must first analyse its needs right from the beginning to conform with the latest medical methods.

In the interests of maximum efficiency, and hence of the provision of the greatest amenity within any economic framework, as much co-ordination and standardisation as possible should be effected. Nevertheless, just as it is desirable that the minima adopted should result from an intelligent assessment of requirements, in the same way sufficient provision for variation should be made.

One of the difficulties in writing this book has been that a hospital cannot be treated as a thing by itself. Hospitals merge imperceptibly into other subjects like town planning and transport. They are also linked up with other arts and crafts, and with garden design and the design of furniture and all kinds of equipment. But all these subjects obviously cannot be dealt with in one book, so for the present purpose, although these subjects are touched upon, I have confined myself to the discussion of the design, construction and equipment of hospitals. To describe and analyse the hospitals of Great Britain presents appalling difficulties to the technical reviewer, for with the exception of a very few, most of them are a conglomeration of additions and extensions.

It is essential to state clearly what this book does not attempt to do. It does not

attempt to deal with the prevention of disease and its possible developments ; it does not attempt to range far into the future ; and it does not attempt to invade the doctor's and hospital administrator's province and to tell him how he ought to run his hospital. It confines itself to the design of hospitals from the point of view of the doctor, administrator and architect, outlining the present position, the tendency of hospital development, and its possible outcome. It is also designed to be of assistance to governing boards and building committees in deciding questions which must be left to their decision. It is not intended to be a treatise on hospital planning and construction, but it does give some indication of the complexity of the subject, and of the number and variety of considerations that enter into the preparation of a building scheme. If satisfactory results are to be obtained without unnecessary expenditure, it is essential that the whole project should receive full and careful preliminary study. I therefore recommend the library of the Royal Institute of British Architects to those desiring further information, in the hope that readers inevitably unsatisfied by my somewhat cursory handling of parts of the subject will pursue its details in larger, more fully illustrated and particularised books.

The requirements peculiar to each department of the hospital must first be carefully formulated. These are the data that must be supplied to the architect and the engineer before they can begin their work of planning. For some time there has been an increasing demand by both hospital authorities and architects for some sort of concise information on the requirements of hospitals, for use when instructions are given by the building committee to the architect. Before the war The Building Centre, London, formed a hospital committee, which produced schedules designed in a form that can be filled in by any hospital authority. There is no intention that any such authority should necessarily use all the space provided, but headings are indicated which draw the attention of all concerned to all possible requirements.

Reference is made to both State and Voluntary hospitals. It must be remembered that there are some voluntary hospitals excluded by the National Health Act. Although as the scheme is worked out there will be some alteration in administrative methods, the planning and constructional aspects will not be greatly affected by the passing of the Act.

Finally, it may be mentioned that in this book it has not been thought necessary to give any space to condemnation of the average pre-war architecture. Presumably all thinking people now agree that it is absurd to erect hospitals that look like miniature castles or the palaces of Renaissance bishops—quite apart from their being extremely inefficient. No arguments are needed against dressing up our hospitals in fancy costumes borrowed from the past : a more profitable occupation is to give our undivided attention to the new architecture of the twentieth century which is at last evolving.

In addition to acknowledging the written advice and encouragement given to me by Sir Allen Daley, Mr. Wetenhall and Mr. Hiorns, I wish to place on record that this book finally reached a printable form largely through the patient suggestion and correction of the manuscript by my wife.

SECTION I

Introducing briefly the history of hospital planning and placing in correct perspective the interested officials and the work necessary to formulate a satisfactory building project

1

The Preamble

SIR GEORGE NEWMAN, in "The English Social Services," wrote: "The art of healing disease furnishes a slow-moving but romantic story. It concerns the growth and application of knowledge, experience, and understanding which almost passes belief. Its foundation was humanitarian sympathy combined with medical science (impregnated in its early stages, and even now, with the elements of magic, folk-lore, and superstition), and this has inspired both the primitive hospitals of the ancient world and the hospital system of to-day. To seek to aid nature in healing disease by medicine and hygiene, and the practice of both in institutions of refuge, thus became one of the noblest objectives of the human mind as far back as the Minoan civilisation of Crete, 4,000 years before the Christian era. 'The history of hygiene,' said Sudhoff, its historian, 'begins with the primeval history of mankind.' From that far-off day was derived the idea of the health temples and hospitals of Aesculapius (god of medicine) as pilgrims' rest-houses for the sick. This was the origin also of the hospitals of Pope Innocent III and the monastic orders in the thirteenth century, which in their turn were the forerunners of British hospitals of medieval and modern times."

It is well known that the public demands on hospitals have much increased in recent years, not because disease has increased but because the discoveries of modern medical science and the means and resources of effective treatment have gradually expanded. In the last one hundred years anaesthesia, antiseptic and aseptic surgery, and trained nursing have come into common use, and together they have revolutionised surgical treatment and brought the whole body within operative compass. Most sick persons do not require in-patient hospital treatment, and in pre-war days out of seven million hospital patients only one million needed "bed treatment," the remainder being treated as out-patients. Nowadays, hospitals are not conducted as "rest houses for the sick poor" (as formerly), but for patients who cannot well be treated thus or at home. They need skilled medical and nursing attention by day and night or prompt surgical treatment. In fact, hospitals are provided for acute infectious disease, critical medical cases, accidents, surgical, and complex midwifery. For more chronic conditions—tuberculosis, venereal, lunacy, mental disease, and incurables—there are special hospitals available, as also for diseases of the eye, ear, nose, and throat.

The English hospitals consisted in 1939, first, of voluntary hospitals (supported by voluntary subscribers); and, secondly, municipal hospitals. The municipal hospitals are, as a rule, conducted by the local authorities and are supported by rates and taxes.

They consist of fever hospitals, poor-law institutions, and special hospitals for tuberculosis, venereal disease, maternity, and mental diseases, as well as acute general hospitals. By the Local Government Act of 1929, the beds under the Poor Law were transferred (or "appropriated") to the use of the general public under the local authorities. The Act separated health policy from the poor law once and for all; it empowered the municipal authorities to provide "curative" hospitals for the general public, appropriating poor-law beds for that purpose; it encouraged co-operation between the municipal authorities and the voluntary hospitals; it co-ordinated the poor law and public health services; and it unified statutory and voluntary services in every area of the country. As a result of this Act, thousands of hospital beds came into the larger service of the general public.

There is no substantial difference in the medical services of the municipal hospitals as compared with the voluntary hospitals. Both are provided with a competent medical and surgical staff; both have efficient nursing, convalescent-home accommodation, almoners, and co-operation with the local doctors, district midwives, and district nursing associations; both provide facilities for healing unattainable by most out-patients—prolonged rest and expert observation, regular medication and special facilities for diagnosis and treatment. Above all, medical or surgical treatment in a hospital should furnish a liberal education in the principles and practice of personal hygiene and preventive medicine.

The continuing effort to provide medical attention for the public at the earliest possible stage of ill-health has led to specialisation and the necessity for avoiding overlapping facilities for treatment, while at the same time making sure that each economic class is provided for throughout the country.

The ambition of contemporary health services is twofold: to provide a system of supervision so widely spread and continuous that serious ill-health has no opportunity of arising; or, where such a supervision fails, to provide means of treatment exactly suited to the ailment. Both these ambitions, and the developments in medicine necessary to make them possible, are of comparatively recent growth. It is only within the last generation that the State has begun to take the health services seriously and the local authorities to supplement the voluntary hospital system with institutions of equal efficiency; and it is only in the last 25 years that departments for specialised treatment have begun to multiply rapidly.

In these dual and to some extent parallel activities of municipal and voluntary institutions the medical world is aware of the dangers of overlapping and competition, and of having several separate institutions all of a very similar standard of equipment and accommodation in the same area.

Unification and specialisation have great potential efficiency and immense practical difficulties to overcome. Medical knowledge and equipment are constantly becoming out of date; and in appreciating the advantage of perfect unification, medical opinion does not forget that, of four competing hospitals in any city under the present system, one will very probably be progressive, whilst one hospital four times the size may

suffer from the conservative inertia which seems inseparable from huge organisation. In the coming change in the hospital system, this difficulty will almost certainly be the greatest, and is realised. Considerable work has been done by a number of committees—who met immediately prior to the war—towards the efficiency of the health services, covering the whole ground of administration, finance, and the efficiency of the various departments.

The importance of a long-term attitude must be considered. In the near future new building schemes may be largely carried out under the stress of urgency and material and financial limitations. The danger of allowing such considerations materially to affect important decisions from all points of view of constructing buildings (which may have an expected life of anything up to 100 years), under the influence of economic factors is so serious that it could virtually amount to a national disaster. Too much time cannot therefore be spent in ensuring that, while reconstruction projects are under consideration, both material and psychological factors shall be exhaustively investigated. To overcome the essential difficulty of the urgency and economy necessary at the moment, yet to avoid the error of flooding the country with accommodation which would be considered insufficient after national conditions have recovered from the war, the principle of designing buildings for subsequent extension has many advantages. Under such circumstances, it would be possible to provide nuclei (backed up by main administrative blocks) which would as soon as possible be extended to conform to non-emergency standards.

The extent and scope of rebuilding will largely depend upon the breadth of vision of such official organisations as may be responsible for its administration. As a town-planning issue, it is obvious that the mere individual replacement of demolished buildings would be the result of an exceedingly narrow outlook. The large-scale demolition which has occurred in some parts has provided considerable grounds for reconsideration of the desirability of retaining many other structures—as yet undemolished. In the interests of maximum efficiency and the provision of the greatest possible amenity within any economic framework, as much co-ordination and standardisation as possible should be effected. Nevertheless, just as it is desirable that minima adopted should result from an intelligent assessment of requirements, in the same way efficient provision for variation should be made.

Next to war, the greatest dangers threatening the human race are the powers of disease. Civilisation has learnt to keep them in check—but only as the outcome of unceasing vigilance. Our hospitals are the centres of vigilance—and to them, buildings and equipment form the very sinews of their fight against illness.

In any form of social experiment it is found that the issue is principally financial. Experiment is more costly than standard practice, and thus much thought has been given towards framing a series of standards as a basis of hospital planning. In this connection, quite frequently reference will be found in this book to The Report. This refers to The Report of the Departmental Committee on the Cost of Hospitals and other Public Buildings, who met in 1933 to consider and report on the annual cost and

maintenance of public buildings, including hospitals provided by local authorities, and paid special regard to

a the establishment and periodic revision of standards;
b modern methods of construction;
c the possibility of securing a reduction in costs without impairing the efficiency of the buildings.

Two reports were published, the First Report in 1937 and the Final Report in 1938. Though they deal primarily with municipal hospitals, their findings will naturally be carefully examined by the executive of any voluntary hospital. It is interesting to note how few are the standards which the Committee felt justified in recommending. Medical and architectural opinion make clear the dangers of standardisation applied to hospital building, and a keen desire to leave the field clear for considerable experiment was clearly shown. It was also stressed by the Committee that a well-conceived scheme can only be produced by the closest collaboration of medical, nursing, administrative, architectural, and engineering advisers before the building programme is formulated. This is a counsel of perfection which is rarely realised in fact, and many building programmes are ill-conceived in consequence.

Also the reference to the London County Council procedure, expresses the views in general of the Departmental Committee on Hospital Standards, set up by that Council in 1931. Their report was never submitted to the Council for adoption as standards, but the findings have been used by the officers as guides to working practice.

Through the International Hospital Association in late pre-war days there was an exchange of ideas and views on the subject of hospital design, both from the medical and architectural point of view, and if this exchange of views is continued in the post-war years the effects over a period of years must be far-reaching. The influence of foreign practice and the general reorganisation of the health services in Great Britain will be the main elements in the new hospital architecture.

The importance of State-aided hospitals in the life of the community has made such strides in public estimation that the energy and expenditure now devoted to them could not have been foreseen 50 years ago. The realisation of this rapid advance has thrown a great responsibility on hospital architects. The criterion for judging any plan of to-day is not whether it is a good plan for present requirements, but whether it will meet those future needs outlined by recent changes in hospital planning. The change in hospital planning, with its great resources, is able to command the best in technical equipment and human endeavour, and so is superseding the private nursing home. The work and efficiency of these public hospitals has in time broken down the old prejudice that, because they were so large, attention could not be so individual.

A review of recent hospitals shows clearly the awakening of an enlightened architectural intelligence in the designing of these pre-eminently utilitarian buildings, and there is every indication that the "institution" atmosphere associated with them will soon be a thing of the past. The scope of the hospital architect increased enormously

when the present traditional plan, in spite of certain opposition, began to undergo radical changes as a result of medical research in hospital accommodation.

From the medical aspects of hospital planning, the pavilion style, so characteristic of British hospital planning during the past 60 years or so, was based on the theory of the aerial convection of infection. This is now recognised as a fallacy, and the effect on hospital design is becoming apparent already. Hospitals may in the future be more compact and will not necessarily be restricted in height; and the saving in time and energy is certain to be considered. Isolation hospitals are becoming things of the past; the pavilion system may be retained in tuberculosis sanatoria, but even this is not certain.

There is, however, another side of the picture. Aerial convection is now discounted, as has been said; but ward infections, not seriously considered in the past, are now recognised as a first-class problem. By "ward infections" specific fevers such as typhoid and small-pox are not meant—these do not occur in any efficient hospital. The group of infections causing concern are less obvious disorders, especially those caused by the streptococcus, and are notoriously difficult to control. Ward infections are not new, but their importance is newly recognised. The placing of glass screens between beds and the placing of beds longitudinally in the ward are measures which have been tried, and which will be retained if their value is proved; but one may be sure such devices alone will not be adequate. In fever hospitals glass cubicles for all patients are the most likely solution, but these are impracticable for the general hospital; some more definite structural change is required.

Single-sided wards which are converted into balconies exist in a number of hospitals; and if the obvious difficulties inherent in such a system of planning can be overcome, the idea will spread. But, in any event, what is more certainly necessary is a reduction in the size of wards and the provision of a large number of single and double-bed wards. This is most vitally necessary in the case of infants' wards, where the risk and danger of ward infection is especially serious; but it also applies to all hospital wards. There are also certain special types of cases which require single ward accommodation for their adequate treatment. Noisy and delirious patients and those who are very ill require isolation not only for their own benefit but for that of the other patients. Enough has probably been said to explain the need for some large changes in hospital ward design.

Hospitals are noisy places and every opportunity must be taken for the mitigation of this evil. The passing of the pavilion system and the need for smaller wards and numerous small rooms for patients is likely to lead to radical changes. It must always be remembered in all discussion of hospital administration and design that hospitals exist for the patients and not the patients for the hospitals.

In this book it is intended to summarise the main trends in hospital policy, because it is impossible to design a successful hospital without knowledge of the wider objects of modern hospital workings. In fact, it is probable that the too general failure of hospital buildings in Great Britain has been caused by the transformation of schedules of accommodation into bricks and mortar without real understanding of what is going to happen inside. In a survey which deals with the surroundings of medicine and

surgery, and not medicine and surgery itself, this summary must necessarily be short, and consequently the danger of under-statement and over-statement must be risked.

One of the discoveries of the present age is that the needs of the future will be different from the needs of the present, and it is the duty of those who plan now to leave as few obstacles as possible in the way of those who plan hereafter. The essence of modern planning is to provide in advance the means of adaptation to the future. There is profound wisdom in this; the human being is beginning to realise that there is something in evolution that is infinitely bigger than anything his own mind can conceive. What is important is not to reach perfection in any one thing, but to leave the way open for continued growth. This point of view was impossible in the last couple of centuries, when those who planned were under the spell of a delusive perfection and when churches and palaces expressed an order that was given from above and imposed by the rules of religion or of society—hence the emphasis on symmetry. The order of the hospital comes from within, and is still in process of evolution; therefore there are no fixed canons of school architecture so far as design is concerned; and therefore symmetry, as distinct from balance and order in design, is of secondary importance.

The aim of the administrator is that the hospital should be as free as possible to develop itself. Ideally every hospital building should be a skin or shell that will change and grow as the living organism within it changes and grows. How far can this difficult aim be achieved in practice? As far as can be seen, there is but one way and one way only to satisfy this, the main requirement of hospital building in all circumstances: it is to choose a site of sufficient area and of suitable levels to allow for all possible extensions—this is the absolute desideratum of hospital planning.

The primary problem that confronted the hospital architect and administrators was how to make the structural life of the building coincide with its useful life as a hospital. Owing to the rapid change in methods of treating disease and to the rising standards of sanitation, heating, lighting, ventilation, etc., it is not uncommon for comparatively new buildings, that are still good structurally, to be out of date. It is now required to design a hospital on such simple lines that future alterations can be carried out with minimum expenditure.

It has been customary in this country to associate planning with the location and construction of hospitals, and sometimes one may have a feeling that British medical and surgical policy is perhaps the best illustration of the national capacity to avoid difficult issues and to leave progress to a kind of unnatural evolution which may have some of the attributes of wisdom, but wisdom of a type which would be fully intelligible only to Alice in Wonderland. Slowly, however, as a result of a revolt from within, a new attitude is being defined which may in time lead to a keener appreciation of the need for intelligent forecasting and intelligent adaptation. The medical world has always been permeated by theories, some of them held by idealists with no full knowledge of the practical requirements necessary to the successful realisation of all ideals, but more often by men who have a large experience of medicine and desire to use that experience in further and more valuable service to the community.

It is difficult for the theorist in medicine to be in the final analysis impractical, because in no other phase of constructive human thinking does progress overtake so rapidly ideal and vision. There is less danger of an extreme view being impractical or dangerous in education than in almost anything else; but unwillingness to recognise this fact has led to wasteful fumbling and indecision.

The medical problem is not really a difficult one, granted decision, courage, and generosity. It becomes extremely complicated if an attempt is made to identify the second-best, the cheap solution, and the cowardly evasion with an effective educational policy. The attempt to save a few thousand pounds in the building of hospitals may lead to much ingenuity in hospital construction, but if the result of this ingenuity is merely an inadequate and unsatisfactory structure, the saving is certainly not worth while.

In this country in the past concentration has been more on sanitary details—in general, cleanliness. On the Continent, particularly in Germany, greater space round ward blocks was given, and the treatment of the surroundings was much superior to our own. In considering the planning of the buildings, it should be remembered that the primary reason for the existence of hospitals is the treatment of sick people in such a manner as to ensure early convalescence. Every factor that can increase the efficiency of the hospital in this respect must be given the fullest consideration. In planning the hospital the doctor as well as the architect must never forget the human side of the patient.

If any substantial category of buildings demands special knowledge and competence on the part of its designers, it is the hospital! As a corollary to the anticipated post-war expansion of the hospital and health centre programme and in view of the importance of skilled planning of hospitals, the American Hospital Association have recently adopted regulations for the admission to associate personal membership in the Association of such architects as can demonstrate their qualifications in hospital planning. Each applicant is judged by the Qualifications Committee consisting of administrator members of the American Hospital Association and qualified hospital architects. The object is to provide the American people with the very best facilities that can be devised to promote and maintain health, and therefore there is no sound basis for permitting any inexperienced architect, however brilliant, to experiment at the risk of producing an inferior building. The planning of a hospital is a highly specialised architectural and engineering task. It must be as nearly a completely self-contained unit as it is possible to devise and in addition it must be specially arranged and equipped for all the professional procedures needed for the adequate care of the patient.

Modern hospital planning is an exceedingly scientific and technical subject, and gives the greatest scope for invention and original ideas combined with a long vision as regards future requirements. The usual stereotyped hospital ward buildings should be considered in the light of modern hospital knowledge. Prior to the first Great War, few doctors gave close study to the planning of hospitals, but in the future to improve the design and management of these important institutions a close collaboration must

exist between doctor and architect. No really first-class building can be designed without an intimate knowledge on the part of one of the designers of every small process of medical and surgical routine and of the administration side of the hospital. For the most part architects look to medical scientists to suggest the ideals to be arrived at; it is, then, for them and the engineers to show how these ideals may be carried out.

In the meantime the architect is being asked to design for both the existing and future systems, and, according to which he is designing for, he must necessarily accept the views of his building committees. His concern is with the practical questions of layout and the grouping and forms of units within the plan. The largest problem is the vertical versus the horizontal plan and the smaller developments in ward sizes and provision for paying patients, and it shows how extremely wary the hospital architect must be. The vertical hospital has great advantages to offer in lighting and convenience for the staff; it is also very permanent, and therefore is likely to be out of date in most ways in 20 years; while the single or two-floored building-group opposes the disadvantages of great distances to a greater ease of alteration when it is out of date. For the moment, the conditions of each building-project almost invariably dictate which type or what kind of compromise is best for particular cases. During the early post-war years hospital architects will probably be most concerned with the provision of specialised hospitals in which the planning and equipment will probably show more rapid advantages than the construction—particularly the equipment and arrangement of easy circulation within special departments.

The saving of unnecessary work for the staff and the convenient placing of utility rooms so that patients in the ward are not disturbed by frequent noises; the provision of efficient lighting and ventilation, and the sense of comfort given by well-considered internal finishings are all factors in planning that favourably influence both patients and staff and add to the efficiency of the hospital.

On looking at a summary of one aspect of the health services of this country, architects should be reminded of another—of the part played in ill-health by the modern tendency to create noise everywhere and anywhere. Silence in hospitals is essential, and the extraordinary prevalence of nervous ailments to-day, when nearly all forms of disease are being steadily reduced, seems to ask for more silence everywhere. It is now possible to design completely sound-proof buildings, provided air-conditioning and very heavy expense are no object. By stressing to hospital authorities, who for once will be ready to listen, the value of money spent on sound-proofing and by continual experiment with those methods which are in any way compatible with modern building construction and equipment they may in building hospitals learn a lot about eliminating a chief cause of modern illness.

Finally, it must not be forgotten that the ideal building is no more than a white elephant if the relations of those who work there, to one another and to the patients, are wrong. The modern hospital must be conscious of its human obligations no less than of its technical prowess.

2

The Formulation of a Building Scheme

There are many ways in which a hospital can be planned, both as regards shape and general design, and the arrangements depend upon the medical requirements and the extent and variety of the provision to be made. The function of the architect is to draw up plans so as to fulfil these requirements in the best and most effective and economical manner, consistent with fulfilment of the purpose to be served. The character and position of the site, whether in the town or country, the amount of land available, and the railway and other transport facilities available are factors which will affect both the form of development of the building and the ultimate cost of putting it into execution.

For the production of a well-conceived scheme, the closest collaboration of medical, nursing, administrative, architectural, and engineering advisors will be necessary, and if possible their combined advice should be obtained even before the site is selected. The collaboration should continue throughout all the subsequent stages.

Unfortunately, in very many cases the site for hospitals has been definitely settled before the architect and engineer have been appointed; and it is therefore emphasised that the expert advice of these professional men should be sought in the preliminary stages, to enable them to make an extensive study of the conditions. This is not generally done before the land is purchased; nevertheless, there can be no doubt that a very great saving can be obtained by adopting this procedure and by considering the sub-soil and possibilities of obtaining water, electricity, gas, and some public sewerage system. The importance of these details, both to the initial expenditure and to the trouble of maintenance, cannot be over-estimated.

A preliminary interview between the chairman of the hospital committee, the medical advisor, and the architect, and in the case of the voluntary hospitals, the hospital administrator with the representative of the appropriate Ministry (i.e. Board of Control in connection with plans for mental hospitals) will be found desirable. A Ministry is only interested when a loan sanction is needed, e.g. it is not interested in voluntary hospitals. A provisional agreement can then be obtained on the general arrangement and layout of the complete scheme, and this can be facilitated by formal discussions with the appropriate Ministry on outline proposals, illustrated by sketch plans, including a fully contoured site plan. Subsequently, sketch plans of each floor of

the various buildings to be erected—drawn to a scale of 16′ to 1″—should be submitted for preliminary approval. An outline specification of the materials and proposed methods of construction should be submitted and agreed before the further detailed drawings are proceeded with.

When the preliminary sketch plans and outline specification have been provisionally approved, the following detailed plans and other particulars are required:

a plan of the site, to a scale of not less than 25″ to 1 mile, showing the buildings, roads, paths, recreation facilities, etc., also the ground-floor levels of the buildings and the original and finished levels of the surfaces of the ground;

b plans of each floor of every building to a scale not less than 8′ to 1″; also, in each case, elevations and sections to a scale sufficient to show details of construction. The sizes of the rooms, the thicknesses of walls, the scantlings of constructional timbers, girders, etc., must be figured on the drawings, and the proposed floor furnishings should be indicated by distinctive tints;

c plan of the drains, both soil and surface water, showing the manholes, with the levels of their inverts and the levels of the surface of ground, also the size and gradient of the drains, the intercepting traps, gullies, ventilating shafts, etc.; if convenient, the same plan should indicate the cold water services and the inside and outside hydrants, but if preferred these may be shown on the engineering drawings;

d full particulars, including drawings, of the sewage disposal works, if any;

e detailed description, with the requisite drawings and illustrations, of the schemes for heating and hot-water services, lighting and other electrical services, telephone, etc.

f detailed estimate of the cost, including the cubic contents of each separate building, and the rate upon which the cost is estimated; also the provisional sums for all extraneous matters and services, but excluding the cost of the movable hospital furniture and professional fees.

To ensure a successful scheme, this complete set of drawings and documents must be prepared to show every detail of the buildings right from the layout down to full-size drawings of even the door-handles. Thus the whole design is predetermined and nothing left to chance or to be worked out on the job; and, in consequence, building operations will subsequently take place without snags or trouble, and all pipes, equipment, etc., are fitted in to their appointed places without cutting or alteration to the main structure of the building. The guiding principle in all cases should be that the more care and time spent on the drawing boards of the architect and in the writing of full and explicit specifications, the less the final finished cost will be, and the better the functioning and therefore the less expensive in operation of the unit.

In working out the scheme in detail, the architect must have the advice of the building committee and submit to them drawings, samples, and explanatory sketches. At each stage the architect must work with and not for the committee; into this working

team he must bring, from the earliest stages, the constructional engineer, the heating and ventilating engineer, and other specialists as they are required during the course of the development of the plan. The possibilities of modern materials and the requirements of modern technique have become so complex that they can only be used properly and to the full if they are considered severally, and as a whole, by a composite team of designers, each bringing his special skill to bear on the common interest. In this team, or "composite mind," must be included one or two of those who will use or administer the finished building.

The interrelations between the governing board, the building committee, the administrator, the consultant, the architect, the clerk of works, general contractor, sub-contractors, and equipment sources appear at first glance to be confusing, and in fact will prove so unless at the outset the governing board selects one individual to be the means of communication between all parties at interest and adheres strictly to such arrangement. If the hospital administrator is competent and experienced in hospital planning and construction he is the logical choice for this post. Otherwise it may be a designated member of the building committee who has the time and experience and is sufficiently interested and elastic-minded to accept such technical advice as may be made available to him.

SECTION II

General consideration of hospital provision and the essential requirements in the initial stages

3

The Site

THE FIRST STEP towards building is the selection and acquisition of a site. Since the modern type of building has a use expectancy of about 30 years this fact should be borne in mind in selection of the site. This use expectancy is based on the obsolescence due to improved hospital methods rather than on physical deterioration of the hospital plant. Not only must present needs be met, but potential future needs should be considered as well. The cost of the site will usually be less than 10 per cent. of the total investment and should therefore be the last thing considered.

Too often the siting of hospitals is an afterthought in growing residential districts. Homes spring up haphazardly, false land values are created, and only expensive, unsuitable sites remain for new hospitals which must serve suddenly increased populations.

Under the old policy, rebuilding was restricted by existing roads, which could not be altered except by obtaining special powers. Some of the buildings in an obsolescent area might not be so far deteriorated as to merit condemnation; cases even occurred when a few haphazardly placed houses of sound condition prevented effective rebuilding of the whole area. The Town Planning Act of 1935 gave powers to local authorities to purchase such buildings compulsorily—even though they were fully habitable—if it were desirable to remove them in order effectively to replan and redevelop an area.

With the increase in planned areas, it is probable that more attention will be given to the requirements of a good site. The siting of hospitals should be decided upon simultaneously with the town planning zoning plan. Siting of the clinic and hospital has special significance in the new community. It should be the nucleus of what American planners neatly define as a "neighbourhood unit"—that is, a community with a limited population housed in a defined area within the boundaries of main traffic arteries. The definition applies equally to independent communities and those which are attached or satellite to towns.

Not only may an increase in the accommodation for patients and staff be required, but, owing to the progress of medical science, a need for new departments may arise which is not, and perhaps cannot, be foreseen at the time when the hospital is being built, and it is therefore necessary to contemplate for the future. Sites considerably larger than those purchased in the past are required to conserve amenity, and this will be apparent when the plan and layout of the modern hospital are thoroughly appreciated, since they will be conceived on altogether more open lines than was

formerly the case. The hospital should be afforded a measure of quiet and privacy from the outside world, and, inside, should have ample space for its activities; for example, tennis for the staff or gardens for the patients to exercise, provided the gradient of the slope is well within the limited powers of the patients under treatment.

The site should be carefully chosen (a cemetery is not a good neighbour for a hospital) and when possible it should be on the outskirts of a large town, away from all sources of noise and smoke, works, railways; also far removed from stagnant water, refuse dumps, or sewage works in order to lessen the annoyance caused by insect pests, e.g. mosquitoes and flies. The direction of the prevailing winds should be taken into consideration for its effects on such conditions. It should be within easy access of the town, but at the same time sufficiently distant to obviate danger of encroachment by building developments. Easy access is essential, and the entrance to hospital buildings must be within walking distance from a bus by a patient on crutches, for there will be many ex-patients who require continuation treatment. From the patients' point of view the question is affected by the type of case to be accommodated. Acute sick should be treated as near as possible to their own homes and therefore large general hospitals should be situated in or near towns. With regard to chronic sick, the ideal would be to treat them in the suburbs, but as relatives prefer to be as near the patients as possible, so as to facilitate visiting, a compromise with the ideal is often necessary. A further consideration that cannot lightly be disregarded is easy accessibility of the hospital from a main centre, so that it will attract and retain the medical, nursing, domestic, and other staffs. Owing to the efficient modern ambulance services, the question of the transport of the patient from his home to the hospital does not now weigh heavily on the minds of the authorities. However, a general hospital should not be too far away from the area it serves, otherwise visitors to patients are likely to find it irksome and costly to travel.

In selecting a site, it is always wise to consider the natural traffic approach. It should be away from the traffic and noise, and therefore access should be from a minor or secondary roadway. An approach from the north ensures peace and quietness for the patients in the ward units. Under no circumstances should the site be intersected by public roads or footpaths.

Preferably, it should be elevated as regards the surrounding country and be level or with a general fall averaging not more than 6 deg. to the south or south-east, with if possible, protection from prevailing winds and with some groups of trees. Where back gardens of houses adjoin the hospital site, a screen of trees is advisable to improve the appearance from the wards and to lessen the noise of occupants of the houses. The retention of any natural beauties on the site is essential, as pleasant surroundings have a beneficial psychological effect on patients, especially those suffering from a disease the treatment of which is long and tedious.

It should be chosen with a view to giving the hospital wards the necessary aspect orientation, and where possible the plot for each block should be selected for its flatness to avoid undue expense in building and levelling, as uneven ground increases the cost of foundations considerably.

A dry sub-soil (uniform sand or gravel) is desirable. It should not be situated over mine workings, and, where possible, mineral rights should be purchased. The subsoil should be carefully investigated as to its ability to carry the building load, the presence of springs or of rock foundations or other characteristics which might affect the cost or stability of building foundations.

The site should be selected where a supply of water is available and where electricity and gas can be obtained, preferably from public services. If the water supply is not available from a public service, it would be unwise to acquire the land until it is clear that a suitable supply of water can be obtained in sufficient quantity to meet ultimate needs. If the foul and surface water drainage cannot be connected to public sewers, sufficient land should be purchased to enable the foul drainage to be dealt with on the site, and as far from the buildings as may be necessary to avoid nuisance. In comparing the costs of alternative sites, the additional cost of any of these services should be taken into account. Every endeavour should be made to acquire a site where the water mains are of sufficient capacity to meet peak demands without any appreciable decrease in pressure, and pressure should be adequate to supply top floors under all conditions. If existing pressure is inadequate, booster pumps must be supplied and adequate main supply to feed the boosters must be assured. In this connection availability of fire-fighting facilities should be investigated. Sewers should be low enough to assure adequate drainage of the lowest levels of the basement and of adequate capacity to ensure against backing up at times of peak loads. Electric service of proper characteristics should be available and the possibility of alternate supplies for use in an emergency should be ascertained.

The question of land required for a hospital building depends, apart from its size and the number to be accommodated, upon the choice of the planning scheme, i.e. whether a horizontal or vertical arrangement is considered more suitable, and this again, will be determined very largely by the choice of site and the acreage available. In general, the building itself should not occupy more than one-third of the total ground area in order to provide adequate space to set the buildings well back from the roadway, to provide parking space and to permit ample outside exposures. In towns where land is costly, a vertical scheme will doubtless be inevitable, whereas in the country there will probably be no difficulty in planning horizontally. If geographical conditions do not preclude freedom of choice there remains the question of which alternative type of planning is to be preferred. The generally accepted rough allowance per hundred patients, when a horizontal layout on generous lines is possible, is five acres. In London, provided there were no restrictions from ancient lights and the like, on a site of four acres provision could be made for about five hundred beds on the multiple-storey principle.

Finally, it is again stressed that a very generous amount of space should be allowed around a hospital. Almost any piece of ground, provided it is large enough, and reasonably compact in shape—preferably rectangular to facilitate economic and orderly planning and administrative convenience—can be made an ideal layout, especially

if a few trees are available. The handicap of too little space is almost insurmountable, and at the present time there are many hospitals, whose development and efficiency are hampered by the parsimonious policy adopted by the authorities in regard to the requisition of land at the inception of the scheme. The aim should be to select a site which, while possessing the features desirable on general grounds (quietness, accessibility, suitable altitude, favourable aspect, etc.), lends itself, by its shape, contours, and the nature of its sub-soil, to economical building. The suitability of the site is the prime requisite and even a donated site which does not meet the requirements in size, location, etc., is likely to prove a liability rather than an asset. One American authority believes that the site should be adequate to permit addition of at least 100 per cent. to the original capacity.

4

The General Layout

A HOSPITAL with all the equipment that modern practice demands is a complex planning problem. The approach to this problem must be free from all preconceived ideas. The precise requirements of the users of the hospital must be known and the plan that is devised to satisfy these requirements must be sufficiently flexible in its equipment to allow for future changes of opinion and for progress in medical science and nursing technique.

Before considering the layout of the hospital and the planning of the various departments, it is well to realise that there is no such thing as a standard layout for a hospital. No buildings become more rapidly out of date than hospitals—that is, if they are to continue to give efficient service to the community. The standard layout is as remote as the standard human being suffering from a standard disease and undergoing standard treatment. The modern hospital is like a living organism trying to adapt itself to an ever-changing environment: hence the last word in the hospital of to-day is the first word in the hospital of to-morrow. New scientific discoveries, new methods of treatment, and even construction, all have the effect of rendering the hospital out of date within a comparatively few years after it is erected. To cope adequately with these ever-changing demands, the outlook of the authorities of progressive hospitals must not allow their layout to be clouded by tradition. When considering the planning of the layout, it should be remembered that the primary reason for the existence of hospitals is the treatment of sick persons in such a manner as to ensure early convalescence. The invariable criterion to be used in the hospital layout is the well-being of the individual patient, hence all functions of the hospital plan should be so related that each individual patient receives the maximum care, service, comfort, and tranquillity with the minimum of friction, duplication, and expense.

A hospital is in reality a young town, made up of many units, each of which may need to expand independently of the rest. The units may comprise, in addition to medical, surgical, ophthalmic, maternity, and children's wards, accommodation for the medical faculty block, with physiological and pathological departments and a library; an administration department and central kitchen, etc.; a casualty department; an out-patients department and dispensary; paying patients block; a nurses' home with night nurses' annexe and a maids' home; a laundry and power house; quarters for resident staff; a chapel and mortuary. All the foregoing apply only to a teaching hospital, of which there are fewer than thirty in Great Britain: in the other two thousand

odd hospitals no special provision need be made for those items which are not needed in a medical school. Again, it is unlikely that municipal hospitals will provide paying patients beds. It is not suggested that every general hospital should have special departments for the in-patient treatment of every disease. There should be medical, surgical, gynaecological, and perhaps maternity wards in every hospital, but for specialities such as eyes, skin, ear, nose, and throat, hospitals should be grouped and wards provided in one of a group of three or four for such diseases. For specialities less frequently needing treatment: such as neuro-surgery, chest surgery, thyroid or plastic surgery, radio-therapeutics, etc., a single department for a group of eight or ten hospitals may be sufficient.

No amount of trouble is too great in the early stages, in order to ensure that all these units shall be placed in proper relation to each other, with sufficient elbow-room to expand to meet possible future requirements. A bad layout will never make a good hospital, and therefore when the committee wish to start on a part of a larger scheme, the architect must insist on knowing the utmost possible estimated extent of future proposals before ever a brick is laid. Principles of layout for economical operation must be applied to the planning of every department. Thus the planning problem should be approached on a well-integrated functional basis. The various working units should be planned each for the most effective and economical operating unit. Then these units should be integrated into relation to each other on the general principle that the zones to be covered by staff should involve the least amount of foot travel. It is only when the economical working unit has been designed and these units integrated into a working whole that the architect should apply his artistic sense to the design of the exterior. Some compromise may be necessary, but none should be made without first determining its effect on the workability of the hospital as a whole and the decision based on a balancing of the relative values between a working unit and any desired external appearance.

One of the principal aims of the layout should be provision for taking as full advantage as is possible of those beneficial elements of nature—fresh air, sunlight, etc.—which can and do contribute so much to the restoration to health of the sick. The Science Standing Committee of the Royal Institute of British Architects investigated the subject of the orientation of hospitals, and stated that the value of sunshine as a therapeutic agent in hospital wards has long been known. Unfortunately, the medical profession in this country, whilst recognising the physiological value of sunshine, have until late years been less appreciative of its psychological value or at best have regarded it mainly as a valuable adjunct to convalescence comparable with port wine and oysters for those who are fortunate enough to afford them. They have certainly failed to bring sufficient pressure upon hospital authorities and hospital architects to secure the provision of solaria in which sunshine on the beds of patients can be used as a curative rather than a restorative agency.

The large ward defines the form of a hospital as a whole, and as a result there has been a very marked similarity in the plans of all British hospitals. It can be said that,

the ward block being the nucleus on which all other hospital services and units are centred, it is natural that ward requirements should receive first choice and the closest attention in regard to general arrangement. The investigation of various designs for wards from different aspects, with due regard to the distance apart of ward units necessary to prevent undue obstruction of useful sunshine, is obviously desirable. Radical changes are naturally being made in the conventional designs of hospital wards, and every endeavour must be made to provide for the maximum penetration of such sunshine as can reach the site.

The Report states that it would be a mistake to attempt to recommend a standard layout. The general plan of a hospital must depend to so great an extent on the size, shape, and character of the site, as well as on many other variable factors, that it must be left to be determined by the circumstances of each individual case.

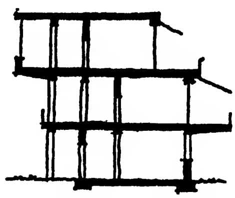
In hospital layouts, there are the rival schools of vertical and horizontal planning, the former prevailing in America and the latter in Great Britain. All variations, caused by restriction of site, method of construction, weather conditions, cost of labour, and financial resources, exist between these two types.

Vertical planning denotes a composite block in which different units of the hospital are on different floors, and in which the architectural composition of the block determines to some extent the area and the arrangement of the units. In this type, the exigencies of certain units must cramp the development of others. In America, sanitation on inner walls and corridors, with wards on both sides, is common. Vertical planning may be the solution in crowded and expensive sites, providing adequate light and air are obtained. In cities, the higher one goes the purer the air, and therefore it is a definite advantage to build high blocks if the angles of light and the circulation of air are maintained.

Horizontal planning denotes a series of blocks each for a particular kind of unit. Some of the blocks may go up to the maximum height allowed, but each block is planned for its own special purpose and does not have to conform to the needs of the unit below or above. The horizontal type of hospital permitted of what should be ergarded as a basic requirement of ward planning, namely, fresh air, sunlight, and open-air treatment for all patients by means of the longitudinal layout or by verandas running the full length of the west sides and the ends of the wards. Ward blocks with complete veranda provision could not be more than two storeys high without interfering with the lighting of the lower wards.

In some hospitals in Germany, Denmark, and Poland, of three or more storeys, the difficulty mentioned above was overcome by setting back the front walls of the wards in order that the bed verandas did not project and cast shadows on the floor below (see Fig. 1). This meant wasteful planning on the lower floors and the difficulty of obtaining large, through-ventilated wards. The vertical type of hospital, in its American form, ignored the requirements of the maximum provision of light and air, and excuse was sought for that in the rigour of the American climate, where temperatures of 100 deg. F. in summer and 32 deg. F. below zero in winter were not uncommon. Thus,

in the vertical type of hospital in America, the temperature was regulated in summer and winter by an artificial ventilation system. The vertical type also permitted of the complete mechanisation of the hospital, whereby equipment, food, records, refrigerators, etc. were supplied throughout by machinery, thus cutting down labour costs, which were especially high in America.



TERRACE SYSTEM
MARBOURG (HESSE) SANATORIUM GERMANY
FIG. 1.

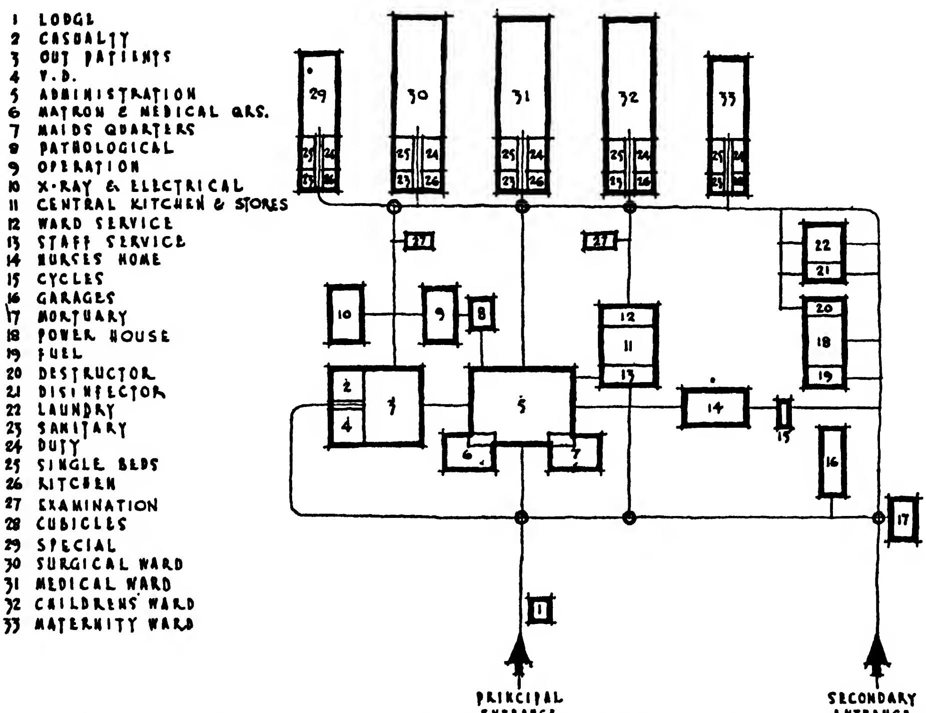
It is understood that American hospital administrators now admit the fundamental defects of the vertical type of hospital. The view is taken that in time, even in America, there may be a reversion to the horizontal type of hospital as opposed to the vertical type.

The British practice, in all cases where the site allows, has been to plan horizontally with two- or three-storeyed blocks, but there may in the future be a definite tendency towards higher buildings. The Report is interesting on this question, for while it does not commit itself, it indicates that, assuming a normal programme, a building of four storey is the most economical in capital cost, though it hastens to state that the difference is not sufficient to make it control the building programme. Nevertheless, it is now being realised that widely separated horizontal blocks are not the only method of obtaining segregation and ventilation; further, that long, low buildings occupying a considerable site area, necessitate much staff movement down long corridors—a tiring and noisy procedure which can to some extent be avoided by a centralised building planned vertically with the aid of well-placed lifts. The advantages gained by centralised services are obvious, and vertical plumbing and service stacks can simplify what is usually a very complicated series of installations. It seems likely also that the higher building of five to eight storeys would be cheaper in maintenance costs —assuming equal accommodation. It should be remembered that simple and adequate means of extension to all important departments must always be possible. Also, precautions must be taken to ensure that higher buildings do not lead to further concentration on an inadequate site at a later date, and light and air must always be generous to all important rooms. In comparing the vertical and horizontal layout of planning, there are points in favour of both, but on the question of extension (which is of primary importance in hospitals) there is little doubt that the horizontal layout is easier to handle.

Every endeavour must be made to free the site from congestion and to let sunlight and clean air penetrate freely between buildings, so that the hospital is a pleasant and healthy place for the staff to work in. The wards should be housed in buildings spaced at sufficient distance to allow sunlight to penetrate between them, so that the buildings are in a garden, with rooms that have sun from the east and from the west, and an extensive view of open space. Vertical planning reduces the percentage of site occupied by buildings, and thus releases space for recreation. To achieve this new freedom it is

essential to use new materials and new structural systems in the light of present-day needs—not in imitation of old buildings.

Easy and good circulation, plenty of light, and good ventilation are of primary importance even with a "roomy" site. Particular attention must be paid to the layout,



GENERAL DIAGRAMMATIC ANALYSIS, NOT DIRECTLY RELATED TO EITHER FLOOR LEVELS, ASPECT OR SIZES, TO ILLUSTRATE THE RELATIONSHIP OF THE VARIOUS UNITS OF A TYPICAL HOSPITAL LAYOUT AND THE GENERAL FUNDAMENTAL CIRCULATIONS REQUIRED

DIAGRAMMATIC LAYOUT

FIG. 2.

so that the various units are arranged to harmonise as nearly as possible with the sequence of actions, and to ensure a maximum of sunlight penetration into the wards, to the grouping of the gardens, etc. In siting the blocks, it must be assumed that on a restricted site there may be a development of high buildings on the neighbouring plots: thus the blocks must be set back on each side of the road. An angle of 18 deg. is desirable between coping of possible highest block and lowest window sill. The spacing between wards must be such that even during the most unfavourable day of the year the wards are sunlit from 9.30 a.m. to 4.30 p.m. The accepted distance between ward blocks is from one-and-a-half times to twice the height of the blocks.

The proper orientation of the hospital layout (see Figs. 2 and 3) may be considered

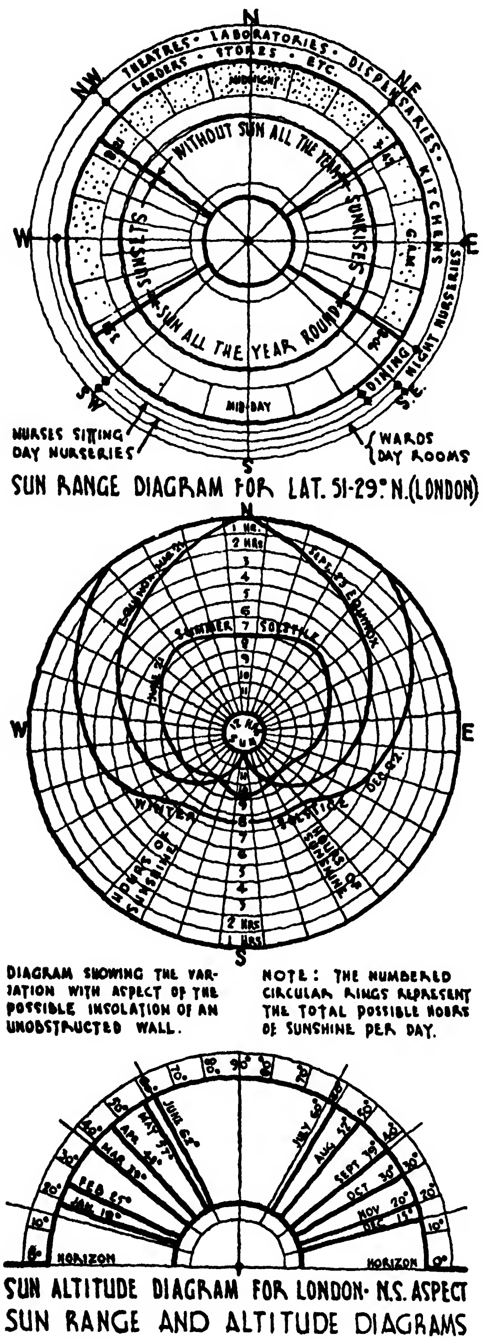


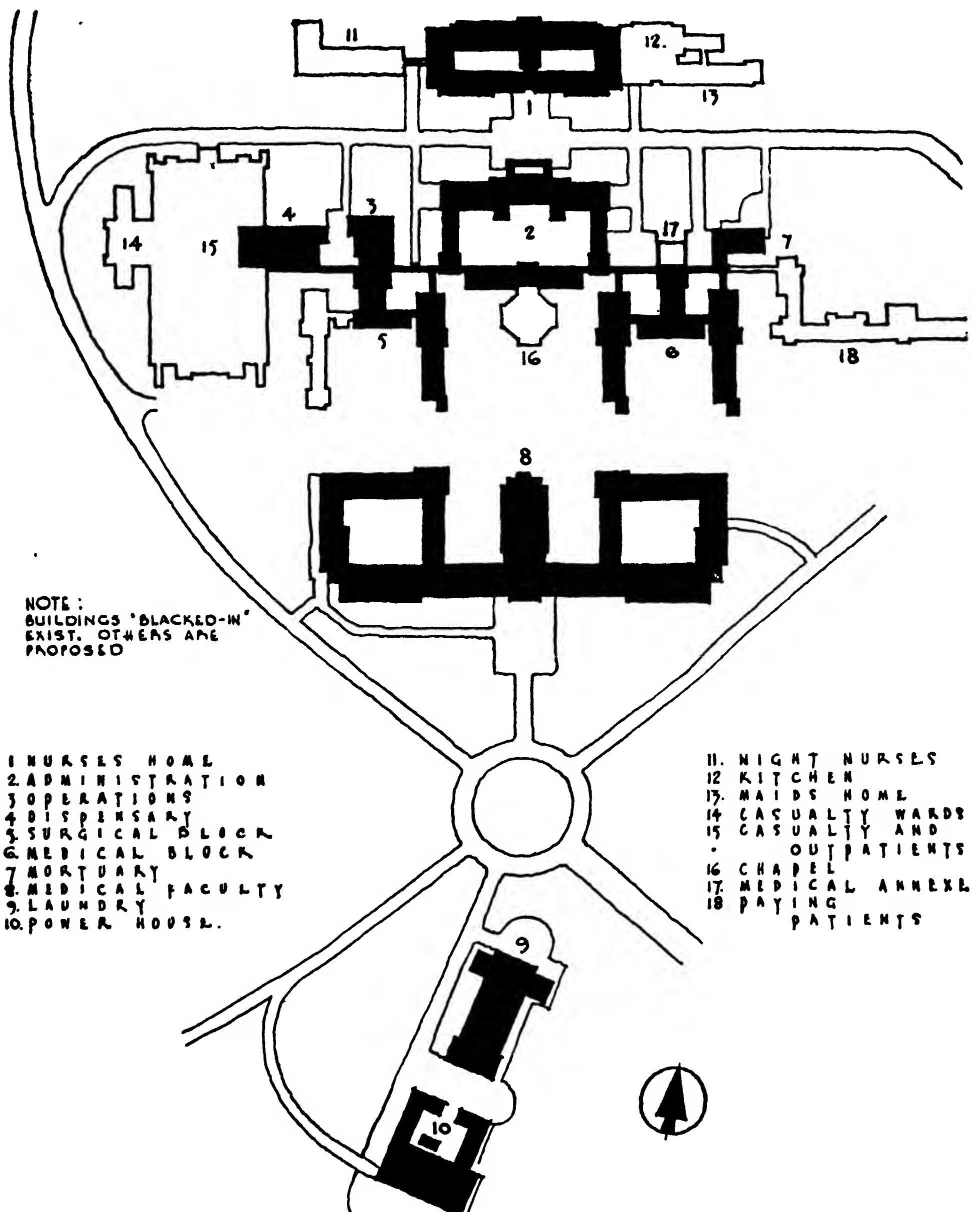
FIG. 3.

as governed by the following general factors:

- *a* type of disease which it is desired to treat;
- *b* the best type of ward to meet (*a*);
- *c* the best spacing between wards and other buildings;
- *d* the desirability of choosing sites and layouts which will secure proper orientation for all the various units.

The wards should be so located that every patient gets sunlight at some time during the day. Locating the building with the axis at a 45 deg. angle to the cardinal points of the compass is one very satisfactory method of securing such exposure. Wards lying north-east and south-west are ideal and better than those lying due north and south, since, with the latter, the west sun strikes across the ward into the patients' eyes. It must be remembered that a hospital starts its in-patients day fairly early—say at 6 a.m.—and finishes somewhere about 7 p.m. For this reason the east is more valuable than the west, more particularly since a slanting west sun is liable to keep patients awake.

First among the study of the possibilities of the site—and the key to the scheme—are "levels of site." Next should be placed "communications," both inside the buildings and between their component units and in respect of road access. The whole scheme is made or marred by the planning of the circular route. The administration block, the hospital buildings, and the faculty should be planned inside the ring road, and it is thus possible to connect them all with covered ways and corridors. These must all be thought out, and such points as service from the central kitchen must be given special consideration.



BIRMINGHAM HOSPITAL CENTRE

ARCHITECTS : LANCHESTER & LODGE

FIG. 4.

The arrangement of the various blocks—as at the Birmingham Hospital Centre—must be thought out in three dimensions, and this is a good example of the logical development of an idea, which is one of the elements of success in architectural composition (see Fig. 4). The placing of the administration and central kitchen—which is in the heart of the scheme—in a central position is emphasised in the elevation by the tower which surmounts it. The medical faculty block, flanked on either side by the physiological and pathological departments, is placed on the southern part of the site, at the nearest point to the university buildings, while the nurses', night nurses', and maids' homes are on the high ground to the north, facing south and conveniently placed in proximity to the administration block and the medical and surgical wards, etc., of the hospital buildings.

To provide efficient circulation with minimum cross-traffic is the most difficult and also the most vital problem in the planning of a hospital. Simple connections between differentiated units make for simplified control by the staff and avoid confusion. In order to diminish the risk of infection, the Southern Hospital in Stockholm is built in such a way that personnel and patients from one clinic or ward never have to pass through another department.

Patients and staff may enter the hospital grounds by the same entrance, but entrances to the principal departments will be separated. It should be possible for the walking patients and friends to go direct to their respective departments. Service entrances should be separated from other entrances and made inaccessible to the general public and patients; and as they are desirable for the traffic of heavy goods and for providing separate access to the mortuary, they must be under the supervision of and readily accessible to the porter at the main entrance. Where the site adjoins two or more roads, the various departments can be suitably approached from these roads, but all entrances must be under the porter's supervision both day and night.

There should be a good flow of circulation between outdoor and indoor units. Access to every part of the buildings and every part of the gardens should be unrestricted. Railings and fences should only appear on the perimeter of the site—if then.

Strict economy should be observed in the layout and formation of the necessary roads. Turning space and parking space for cars should be provided. Main motorways should be 16′ wide and service ways 10′ wide, with turning or backing space at service entrances. Paths should be 3′ 6″ wide. The best surfacing for the paths is some form of concrete or paved finish—it is economical to maintain—as smooth as possible without being slippery.

In planning the general layout of the various departments, the wards should receive preferential treatment, facing a little east of south. Since the hospital is an establishment intended to receive and treat the sick, the accommodation for patients should receive first consideration. The ward blocks, therefore, should be sited and oriented so as to provide the maximum sunshine or natural light and ventilation, freedom from noise, cheerful and healthy surroundings, effective veranda or solarium accommodation, etc.

The administration department, including offices and, if necessary, quarters for the

medical staff, matron, steward, etc., central kitchen, stores, and other services, should be conveniently situated in relation to the hospital as a whole, and generally placed in a central position readily reached from the main hospital entrance. Whatever happens, the central kitchen and store departments must be a centralised unit equidistant from the various sections of the departments served, and yet far enough away to prevent the smell of cooking and the noise of these departments from reaching the wards and homes. Easy access for deliveries from outside must be provided.

The casualty and out-patients department should be approached separately and be near the entrance of the site. In this connection, however, it must be remembered that the radio-diagnostic and physio-therapy departments should be suitably placed to serve their respective purposes efficiently and economically relative to both the hospital itself and to the out-patients department.

The isolation department of a general hospital must be sited to be easily supervised from the central administration offices. It must also be readily approached by ambulances in order to convey patients direct.

The position of the mortuary should be one of isolation and privacy, away from the ordinary hospital approaches and exits and the walks of the patients and their friends.

The central power house, with the laundry near by, should be so placed that the direction of the prevailing winds will ensure that the smoke from the chimney is carried away from the wards, and yet be placed as centrally as possible to reduce heat loss and main pipe sizes.

The homes for the nursing and domestic staff should be away from the main hospital buildings proper, but near enough for connection to these buildings by covered ways. A private garden and tennis court are desirable for the nurses' home.

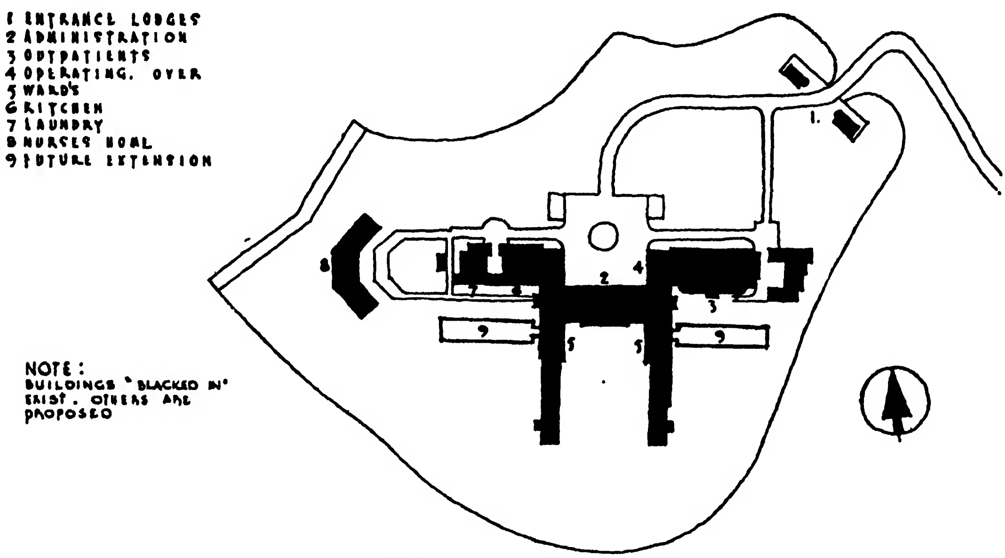
The car park, cycle store, garage and ambulance shelter need very careful placing; otherwise they will spot the plan unduly. Each relates particularly to other buildings on the site. Ample parking space should be available for visitors' cars.

Hospital buildings should, whenever practicable, be set well back from the surrounding roads with a spacious forecourt, thus adding to the comfort of the patients. Apart from architectural reasons, the provision of a forecourt provides adequate parking space and ensures the necessary quietude for the various units. Any factor that increases the efficiency of the hospital in this respect should be given the fullest consideration.

The general diagrammatic analysis given in Fig. 2 is not directly related to either floor levels, aspect, or sizes, but illustrates the relationship of the various parts of a typical acute general-hospital layout, and is intended to make clear the general fundamental circulations required. It should be noted that the wards are grouped together, which is particularly necessary for food service.

As examples of hospitals standing in their own grounds, as against a hospital erected on a congested site, the Birmingham Hospital Centre and Scarborough Hospital are compared with Westminster Hospital. The accommodation of the latter is given in more detail to indicate the amount of accommodation provided on this restricted site. All these hospitals were erected around 1935.

Birmingham Hospital Centre (see Fig. 4): this provides accommodation for eight hundred patients and all the departments of a modern teaching hospital and a medical school. The hospital is erected on an open site, with a considerable fall from west to east. The main axis of the scheme is almost due north and south, with a main east and west corridor. The wards are planned to the south of this corridor, the other units to the north. Access is obtained by a road running between the main hospital building and the nurses' home, which is placed along the northern edge of the site. The medical school is to the south; it is a comparatively low building and does not obstruct the sunlight to the hospital wards.



SCARBOROUGH HOSPITAL
ARCHITECT · W MARCHMENT

FIG. 5.

Scarborough Hospital (see Fig. 5): the hospital provides accommodation for one hundred and forty patients and is planned so that extensions may be made to double the present number of beds, while the ancillary accommodation is arranged to cope with the future additions without structural alterations. It is built on a steeply sloping site with a rather flat area at its highest point, and therefore demanded the concentrated planning of the accommodation for the patients, which is planned in two wings pointing south, while the administration department, central kitchen, etc., are planned at the west end of the wings and joining them. The maternity department, on the ground floor of the east wing, is insulated against sound, as also are the private patients wards.

Westminster Hospital, London: the buildings—hospital and nurses' homes and medical school—are placed on two separate plots on the east and west of St. John's

Gardens, Westminster, with Horseferry Road on the north and Page St. on the south. There is a subway under the pavement of Page St. connecting the two buildings, and the boiler-house is in the basement of the nurses' home, as this building was completed first. The hospital building is on the east of St. John's Gardens and provides accommodation for four hundred patients (including forty-four private patients). The plan is arranged to obtain as many wards as possible overlooking St. John's Gardens. The problem of providing entrances for ambulances, walking patients, medical staff, visitors, etc., presented special difficulties owing to the nature of the site and the traffic regulations. After much discussion it was decided to arrange a "one-way" road through the centre of the building, running north and south, with a 6′ wide pathway for pedestrians; and all the above entrances are arranged to open on to this road (see Fig. 44). The medical school is at the north end of the nurses' home on the west of St. John's Gardens, and is planned as a self-contained, separate building, with openings through to the nurses' home for fire-escape only. In the basement are gymnasium, squash court, changing rooms, etc. On the ground floor are the refectory, with cafeteria at one end of the room, smoking-room, common room, and a lecture theatre to seat two hundred and fifty persons. On the first floor are the museum and library. On the upper floors are the laboratories with windows facing north, small lecture rooms, staff rooms, etc., also bedrooms for the resident medical staff. The nurses' home occupies about two-thirds of the site on the west side of St. John's Gardens and has the main entrance at the south end of Page St. In the basement are the games room, trunk store, linen store, etc., and the boiler house. On the ground floor are the offices for the sister tutor, etc., visitors' room, lecture room, library, dining-room, and kitchen. The dining-room and kitchen are placed on the ground floor in order to save time during the nurses' luncheon interval, as meals are provided in the nurses' home. Immediately over the offices at the south end of the building are the teaching ward, for student nurses, fitted with all ward accessories, a teaching kitchen, and also a sick bay for nurses. On the first floor of the nurses' home, facing St. John's Gardens, are the recreation rooms and the large room for senior nurses, which opens on to a paved terrace overlooking the Gardens. The upper floors provide accommodation for the nurses' bedrooms. The sisters' quarters are arranged at the south end of the building. There is a separate staircase and lift provided for the nurses and sisters, and an ironing room, tea pantry, and shampoo room are provided on each floor. On the top floor there is another games room opening on to the flat at the south end of the building. The out-patients department is arranged on unusual lines and is planned vertically instead of horizontally. The object of this arrangement is to save waiting and to link up in-patients and out-patients treatment as far as possible.

The three previous examples are of large hospitals each containing accommodation for up to several hundred patients. Figs. 6 and 7 illustrate as a comparison, respectively, the Cottage Hospitals at Welwyn and at Dawlish.

Before concluding this chapter, a few words on the treatment of hospital grounds will not be amiss. The treatment of the outdoors calls for imagination, particularly

when space is confined, as it is so frequently. It should be conceived as a "garden" rather than "hospital grounds" in the too familiar meaning of those words. The gardens should be reasonably informal, but not without a sense of order, and they should, of course, bear a definite relation to the hospital buildings. They should be full of suggestions, places to explore, mounds and hollows, ramps and trees, croquet, clock golf, etc., for they greatly add to the appearance and psychological effect upon patients and staff. In the grounds should be partly covered shelters, large enough for convalescent patients to take shelter from the winds, showers, etc. There should also be as large an area as possible of grass lawn, flat for the most part to facilitate mowing, but with a grass bank, if there is room, for the patients to recline on. Tool-sheds should be provided and sheds to store deck-chairs and rest beds.

The provision of a kitchen garden will be considered essential in the country hospital. It will be large and fully equipped, and the layout will include some frames, greenhouse, and so on.

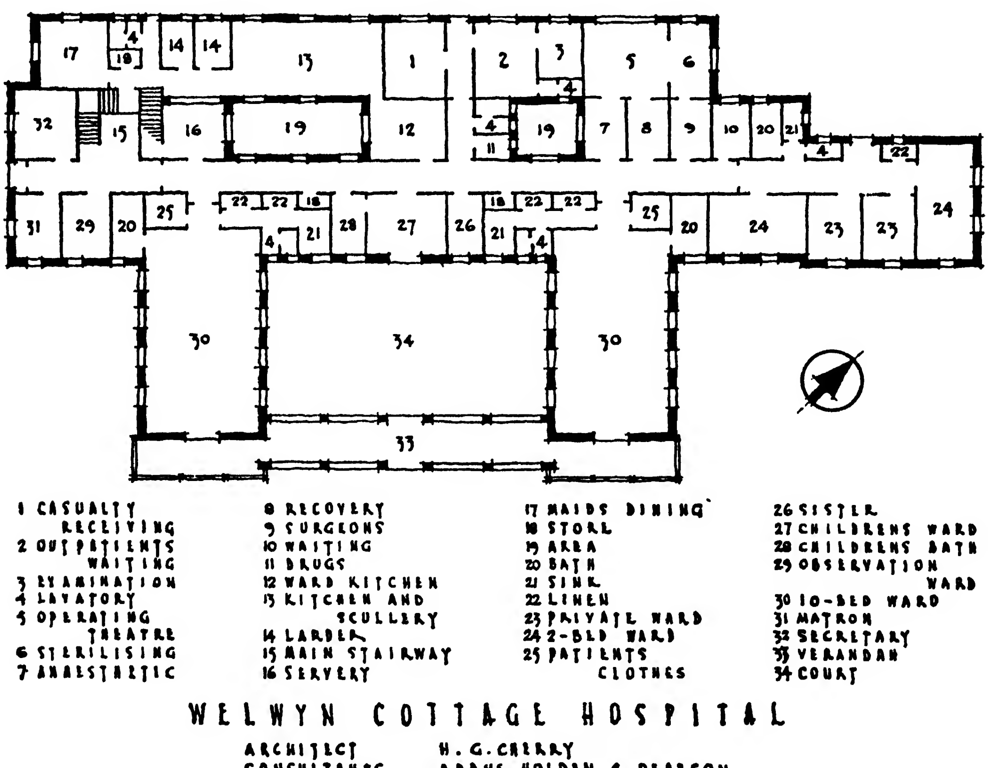


FIG. 6.

Finally, it is most desirable to provide ample recreational facilities for the staff, particularly in hospitals which are not within easy access of large centres of population. The size of the site will largely govern the extent of the provision of outdoor recreation,

such as tennis, etc. The general arrangements, however, for providing recreation for the staff must be left to the resources of each hospital.

To combine these various buildings successfully into a coherent organic whole, without violating architectural decencies, demands considerable skill and an intimate knowledge of the working of a hospital on the part of the architect. In fact, the practical considerations involved in the planning of a modern hospital demand not only a specialised training of the architect but also the collaboration of the hospital administrators. They must study closely the relationship of one unit to another, the positions of the entrances and exits of the different departments, and the various streams of internal traffic, so that confusion is avoided and an orderly functioning of these departments is ensured. To use architectural terms, such general principles as unity, punctuation, and inflection must be observed as meticulously in the external arrangement as in the internal design of the wards, etc.

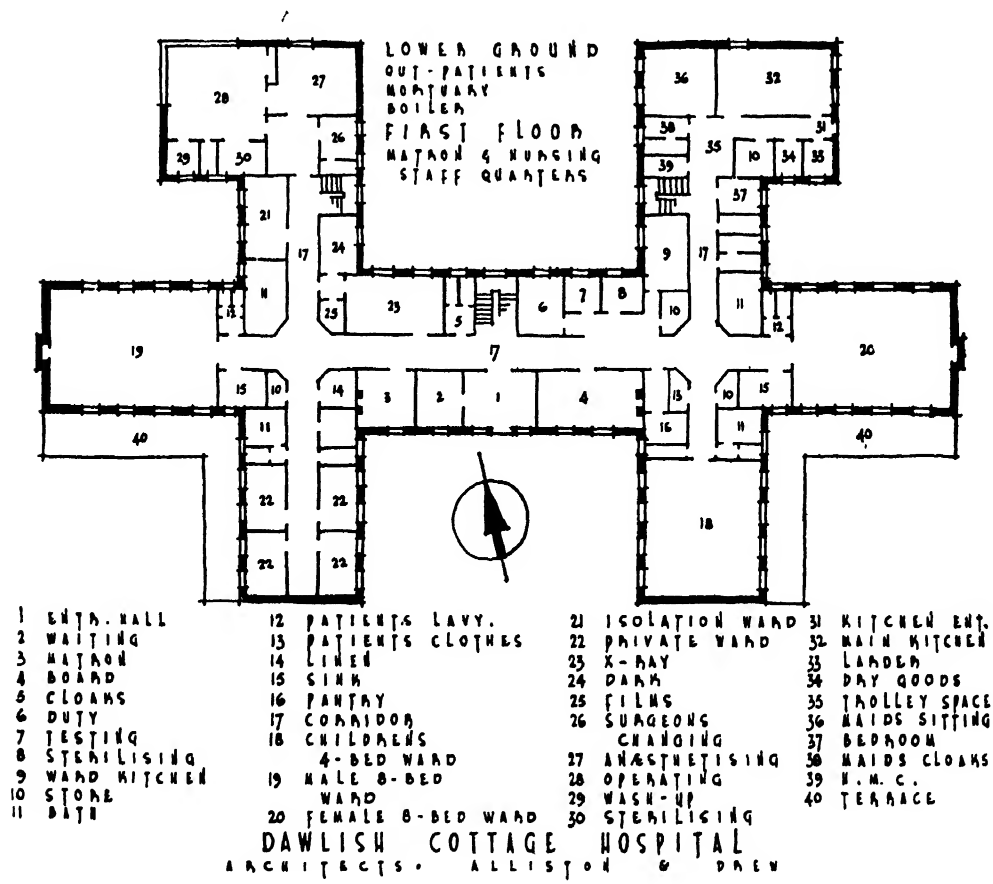


FIG. 7.

SECTION III

Administrative—Detailed consideration of the several departments necessary before a hospital can accept patients

PLATE I. Corridor
Royal Masonic Hospital, London

PLATE II. Corridor
Isolation Hospital, Paisley

[*To face page 36*

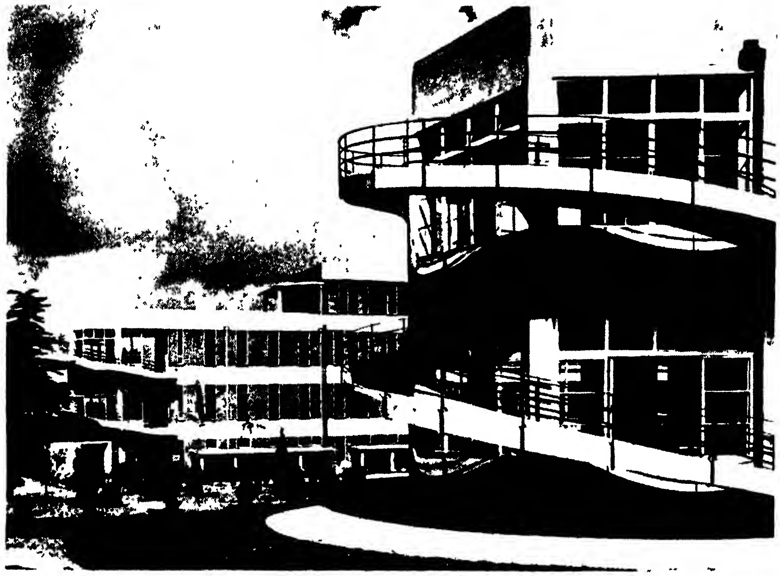


PLATE III. External Ramps
Kent and Sussex General Hospital

PLATE IV. Boilers with Automatic Stokers
Hospital Centre, Birmingham

To face page 37]

5

The Communication Between Units

IT IS VERY IMPORTANT in planning a new hospital to consider the best means of communication between the administration department and other departments of the hospital:

a for transit of staff, patients and food, etc.;
b for speaking.

For transit there are connecting corridors, stairways, and lifts, and for the latter telephones and light signalling, which is reviewed in Chapter 37.

The extent of the main corridor and the number and disposition of staircases and lifts will depend on the general plan adopted. Every ward unit above the ground floor should have access to two staircases capable of taking stretchers, and in all but small hospitals should have access to two lifts. These should be designed to make easy circulation between the main administration departments and the wards. For reasons of economy it is desirable to restrict the amount of building devoted to corridors to as little as the plan will allow, and the question of communication by corridors, staircases, and lifts must be considered as a whole.

A further point to be kept in mind is that the chief centres of internal noises are the lift-wells, staircases, and the main corridors; so far as possible, therefore, these should be disposed with a view to the minimum disturbance of patients.

CONNECTING CORRIDORS

Though primarily for circulation of staff, the corridors must be wide enough to allow trolleys to pass. The usual width is 8′ to 10′ for the main arteries and 7′ for the branch corridors to wards. The Report recommends a width of 8′ for the main ones. They should be widened at circulation and meeting points and at landing points of stairs or ramps. Circulation has to be efficient and smooth; therefore lockers or display cases are not suitable in corridors unless recessed. Provision should be made for trolleys by forming bays, which can often be used as lighting recesses at the same time.

An upper corridor or bridge to connect two buildings is not costly and saves much walking.

The corridors should be well lighted and where possible 50 per cent. of the windows should be of opening types. When central corridors are essential, they will be top lighted and ventilated, but these central corridors should be avoided except for very short lengths.

Cross-ventilation is not essential for the normal corridors, and the problem of getting cross-ventilation to small wards, etc., is dealt with fully in Chapter 18, where it is explained that this is usually provided by opening fanlights over doors. If cross-ventilation is required to corridors and wards, etc., it can be obtained by having a detached corridor. By this means, both the corridor and the wards, etc., are given light and ventilation on two sides and both can have two all-opening window walls. Disadvantages of this arrangement are expense; elongated circulation, involving elbowed corridor access to rooms; and the forming of areas too small to be of any real use, too shady and damp to be kept attractive.

All doors should open into rooms except for doors to certain units and departments, which must open outwards, in which case a recess at least equal to the width of the door will be provided. Entrance doors and doors for alternative means of escape will always open outwards.

As a design device "that helps the patient help himself"—such things as rails along the walls of corridors, lobbies, and the like may be considered desirable.

STAIRCASES AND RAMPS

Some form of vertical communication other than lifts is necessary for two floors and upwards, and this can be provided by either staircases or ramps. It is possible to use ramp communication in certain special instances, but ramps should never be used without full consideration of the fact that such communication is labour wasting and may even be hazardous if used for any type of wheeled transport.

Staircases and ramps must be well lighted, preferably from the sides. Normally, the windows are hung from the landings and are high, running throughout the stairwell. Accordingly, provision must be made externally for cleaning, and this can be done—as at the Royal Masonic Hospital, London, where the stairways are provided with a metal cornice providing a hanging for window-cleaning cradles.

In order to facilitate cleaning of staircases and ramps, a grill should be provided at intervals through which dust can be swept. A hose connection for washing should also be provided.

Staircases are the usual means of communication, and they must be of fire-resisting material; normally, they are of reinforced concrete with cantilevered landings, which are continuous with the stairs themselves. They can be finished in terrazzo with special non-slip insets, and with terrazzo dado run continuous with the treads and risers. The balustrade can be of wrought-iron or solid construction faced with either terrazzo or hard plaster and finished with hardwood handrail. A handrail is required on both sides of stairs.

Rules for the design of hospital staircases are:

- *a* access to stairs should not be more than 120′ from any point on upper floors;
- *b* treads 11″ to 12″; risers $5\frac{1}{2}$″ to 6″;
- *c* not more than twelve risers between landings;
- *d* width, not less than 4′ 6″; if divided by balustrade, to be not less than 10′ overall;
- *e* full landings must be used; winder treads must never be incorporated; landings must be wide enough to turn a stretcher; this width is considered as 6′;
- *f* when giving access to halls or corridors, staircases should be set back at least 2′.

Ramps are quite an innovation in this country, but they may quite well be a feature of future design. They were used externally at the Kent and Sussex General Hospital (see Plate III).

Unless they are shallow, and therefore very long, danger of uncontrollable momentum is considerable. If ramps are provided, the following rules for their design must be observed:

- *a* access to ramps should not be more than 120′ from any point on upper floors;
- *b* slope must not exceed 1 in 6;
- *c* they should rise in one continuous slope without breaks or bends;
- *d* width not less than 4′ 6″, and if to be used for up and down traffic, to be separated by central handrail, and the overall width not to be less than 9′;
- *e* when giving access to halls or corridors, they should be set back about 3′;
- *f* handrails should be provided on both sides;
- *g* they should not have blank walls on more than one side. When totally enclosed, there is a sense of confinement, also a difficulty in gauging the slope. Ramps should be lighted from one or both sides, not from top or bottom landings.
- *h* construction must be fire-resisting, i.e. reinforced concrete;
- *i* floor should have a good but not excessive co-efficient of friction: matt linoleum or high-density cork is good; rubber is suitable if its high co-efficient is not reduced by polishing.

LIFTS

The modern hospital depends almost entirely on lifts for vertical circulation. Many types of buildings, up to four storeys in height, could be operated without lifts, but in a hospital a lift becomes indispensable for anything over one storey in height.

In all but small hospitals wards should have access to two lifts. The total number to be provided will depend on:

- *a* the number of storeys;
- *b* the number of beds above the ground floor;
- *c* the type of plan.

In a hospital requiring more than one lift it is normally considered advisable from mechanical, operational, and economic standpoints to locate all lifts together. But in the hospital a further item to be considered is that of fire hazards. Fires most frequently originate in the basement and tend to spread upward by way of lift shaft and stairwells. Likewise the panic caused to patients by fires is commonly a greater hazard than is the fire itself: for that reason it is generally accepted that horizontal evacuation of patients out of affected areas is one of the prime essentials in patient protection. Consequently when two or more lifts are to be installed it is advisable to have them as well separated as possible in order that a fire in the shaft cannot easily cut off access to the lift. This arrangement permits relatively easy evacuation of patients from the immediately involved area and the realisation that the other lift is in working condition will do much to calm their fears. In view of the economy of travel attained by placing lifts together, this protection is sometimes given by locating the lifts together with the shafts well separated by fire walls. As a matter of fact, under present conditions of fire-resistant construction, a moderate amount of immediate fire-control equipment and the speed and efficiency of modern fire equipment, actual evacuation will rarely be necessary. But if an early appraisal of the situation indicates that such evacuation is necessary or even desirable on account of smoke, such separation of the lifts may avert a panic or prove an actual life-saving measure.

Adequate service can be given with the minimum number of lifts if there is main corridor communication on every floor, but the cost of providing corridors on every floor may be greater than that of increasing the number of lifts. Where the lifts are in staircase wells, they should be enclosed by wired glass panels built off the balustrade.

It must be remembered that one of the chief centres of internal noises is the lift wells, and therefore the lifts require careful siting. To provide quiet lifts, not only is quiet winding gear required, but silent car-levelling devices and properly mounted, totally enclosed lift wells. Noise due to opening and closing of lift gates can be minimised by using sliding or hinged wooden doors. Gates of the expanding metal type are ordinarily noisy, but although silent models have been designed with quietening rubber buffers between the vertical elements, this type is not really suitable for hospitals, as it is so liable to dirt collecting. Winding gear is preferably installed in the lowest floor rather than at the top of the shaft, as the noise is then less likely to cause disturbance. With gearless motors, silent and vibrationless running can be effected. Precautions against vibration and the construction of lift wells are reviewed in fuller detail in Chapter 36.

All hospital lifts should be controlled by the method known as "collective," which requires "up-down" push buttons at the landings with the usual push-button box in the car. Intending passengers press the button appropriate to the direction in which they wish to travel, and the car travelling in this direction will stop automatically. When leaving the car empty it is not necessary to close the inner gate, and the outer two-leaf doors, when sliding, are weighted to be self-closing, so that it is impossible for negligent persons to detain the lift at a landing.

The high speeds combined with push-button operation necessitate the employment of multi-voltage control, which gives rapid and smooth acceleration and enables the cars to stop level with the floors regardless of load or rope stretch. The self-levelling equipment maintains the car at floor level regardless of addition or removal of load. The operation of these lifts by the "vernier cushion control" is one of the most recent and successful advances made in lift construction. The slightest jerk to a patient may prove fatal, and this patent cushion control accelerates, decelerates, and glides to rest in one continuous motion and with absolute accuracy and smoothness. Hydraulic lifts are unsuited for hospital purposes.

The most acceptable hospital lift is based on a platform dimension of 5′ 8″ wide by 8′ 4″ in depth with door opening of 3′ 10″. This is calculated for the accommodation and manoeuvrability of two stretchers with necessary attendants. The number of lifts would depend on the anticipated load. In any case, the capacity should be designed for handling peak loads, because in a hospital capacity is calculated to visitors rather than patients. A good general size for lift wells is 7′ 3″ by 10′ 2″. Bed lifts should have rubber floors and dado, and run at 100′ per minute. The average hospital lift spends more time in loading and unloading than in travel, and speed of travel has become a secondary consideration.

In large schemes high-speed passenger lifts, to carry, say, ten persons each, and running at 400′ per minute, should be installed in addition to bed lifts; also goods lift with capacity of, say, one ton and a speed of 100′ per minute, and small, press-button operated food service lifts if they can be incorporated for direct service to ward kitchens.

Electric supply will be required for the lifts. The power necessary for stretcher lifts and lifts in nurses' home at normal speeds (100′ per minute) will be 7½ h.p. for a 12-cwt. stretcher lift, and 5 h.p. to 6 h.p. for passenger lifts.

MEANS OF ESCAPE

The provision of means of escape in case of fire is of the first importance. In planning, it should be borne in mind that for sick people a horizontal means of escape is safer and more convenient than a staircase.

A fire-escape staircase should, however, be provided at or near the end of every projecting wing over 60′ in length in old buildings which contain patient accommodation above the ground floor (90′ in modern buildings constructed of fire-resisting materials throughout). The external staircase in light steel or reinforced concrete, so often adopted, is unsightly and has the disadvantage of being dangerous in frosty weather. Enclosed fire-escape staircases are therefore to be preferred. If designed as an integral part of the building, as they should be, they are unlikely to cost more than open staircases, while the maintenance costs will be less.

Access to the fire-escape staircase in the transverse layout should be from a veranda or balcony whenever it can be conveniently arranged (see also Chapter 18). Where the

staircase is entered direct from the interior of the building, there should be self-closing doors to prevent the entry of smoke.

Rules of design applying to the main stairways apply also to fire-escape stairways.

In connection with means of escape, the following provisions for dealing with an outbreak of fire are mentioned:

a the provision of a fire alarm system to enable an alarm to be given easily by the staff;
b the provision of an adequate water supply;
c the installation of fire equipment to cover the risk;
d the installation of small appliances—e.g. extinguishers—to deal with fires in their initial stages.

SUBWAYS

In any large hospital scheme it is usual to connect all departments together with subways below ground-level. These will be used for the service of meals by the electric trolleys and by the staff on inclement days. Under this subway (really a connecting corridor) or adjoining, will be a subway or trench containing the electric mains, heating, hot and cold water supplies, drains, telephones, and other services. This service subway is essential with a central power station.

When the subway is used for the internal service of the various departments, it will be the same width as the corridors and at least 7′ high in the clear; but when used only for service pipes, etc., the width will be restricted to essential requirements, and the height will be restricted according to whether steam pipes are installed or not. When steam pipes are provided, the depth will be sufficient to allow a man to walk upright; otherwise they may be in the form of trenches which are of shallow depth and provided with removable covers in the corridors for easy access.

In connection with the subways—and with the foundations—creepways are necessary under the lower floor of departments such as central kitchen, out-patients, etc., for the mechanical and electrical services—these need to be deep enough to allow a man to crawl through them. A headroom of not less than 4′ at any point is considered the minimum for carrying out maintenance and any alterations. Where pipes have to be carried under suspended floors, they can be laid under these floors without requiring the provision of ducts, if access is available.

From the subways vertical ducts are carried up the building at convenient positions, so that the pipework of the various services can reach the respective apparatus without being visible in the units. These main vertical ducts should be sufficiently large to permit a man to work inside them.

The subways may be built of brick or concrete and should be so constructed as to prevent the access of water, which if accumulated in the ducts might destroy the heat insulation on the pipes. The best position for the main subways is under the connecting

corridors, as the corridor foundations can be carried down to form them. The floor of the subway should be sloped to form a channel for purposes of easy sweeping, and drained to several points.

FINISHINGS

Too much care cannot be given to the finishings of corridors, for not only should they be bright and cheerful, but the materials selected must be suitable for hard wear. This also applies to stairways, etc.

Floors. Possible floor finishes for the corridors are:

- *a* terrazzo (with non-slip carborundum finish or rubber inset of Portland cement matrix);
- *b* non-slip tiles;
- *c* high density cork or wood composition;
- *d* coloured asphalt;
- *e* jointless rubber or felt or matt surface linoleum;
- *f* rubber;
- *g* or a combination of two of the above (i.e. rubber with a margin of terrazzo).

Coved skirtings are important whatever the floor surface.

For the main hospital corridors and for the branch corridors the better-class materials will be used, whereas on the basement corridor floors and to stores, etc., granolithic or asphalt will suffice.

Walls and Ceiling. Walls should be washable within finger range, light or bright in colour. Coloured tiles or terrazzo or one of the patent glazed finishings are attractive and practical; above the dado, the possibility of washable, cheerfully coloured or patterned cloth wall coverings should not be forgotten as an alternative to washable paint.

One very effective means of protecting the walls is to substitute for the cove a diagonal at an angle of 45 deg. with the skirting and margin and having a base and height of 3″ to 4″.

It should be noted that, with a view to lessening noise in corridors, The Report recommends ordinary plaster rather than hard plaster, except where the latter is required on account of liability to damage—say up to about 4′ 6″ high. For lower floor corridors and secondary staircases and corridors adjoining stores, etc., smooth brick with paint finish will suffice.

A first-class finish to corners can be provided by stainless-steel corner strips, 4′ 6″ high, or, as an alternative, hardwood.

Ceilings, of whatever material, should be light in colour to reflect maximum daylight.

Doors. All wood or metal doors should be flush, of reliable manufacture; and glazed doors should have armoured plate glass.

The fire-resisting doors and their frames must be of teak or other hardwood and glazed in the upper portion with fire-resisting wired glass. The doors should be protected with bars on each side.

Windows. Windows should be designed with 50 per cent. opening capacity. Centrally pivoted hopper types are most suitable. Sills should be tiled, with coved corner upstand of tile.

Artificial Lighting. There are no special rules for lighting of corridors. "Port-hole" or built-in ceiling lighting is suitable.

Artificial lighting should fall on staircases from above and below in order to avoid deceptive shadows.

Heating. Any heating elements (i.e. radiators) should be recessed. The heating circulation should be arranged so that a temperature of 50 deg. to 60 deg. F. can be maintained.

PLATE V. Entrance Hall
General Hospital, Northampton

PLATE VI. Administration Office
Great Ormond Street Hospital for Children, London

[To face page 44

6

The Administration Department

THIS CHAPTER considers the requirements of a group of general services for which provision is commonly made either in a single administration building or in a group of contiguous and closely related buildings. Before reviewing the requirements of this department, it is well to consider who are the principal organisers of any hospital for whom accommodation is required.

PERSONNEL

Superintendent or Chief Administrator. There is at the moment much controversy as to whether the superintendent of a hospital should be a layman or a medical man. This no doubt is due to the increasing tendency amongst municipal authorities administering hospitals to appoint medical men.

An elaborate scheme of organisation is required to treat the modern patients, and every department and other service in the hospital is always directed towards the one end—that is, the cure of the patient. These manifold duties and responsibility fall to the chief administrative officer whether, as usual in the case of the municipal hospital, he is the medical superintendent or, almost without exception in the voluntary hospitals, a layman experienced in hospital administration.

As the method of administering the two types of hospitals differs very considerably, it is not possible to specify in detail the accommodation for both in common terms. The fact that much of the administration and servicing of the municipal hospitals is not infrequently done from the centre of the municipality, i.e. by remote control, whereas in the case of the voluntary hospital the management of the institution is wholly autonomous and worked on the spot, is also reflected not only in the duties of the chief administrator but in the departmental arrangements in regard to stewarding, accounting, and in many of the other departments.

The general concensus of opinion is for the superintendent of a hospital to be a qualified doctor. A man with medical experience is in a much better position to deal with complaints of patients and their friends, as well as to solve the administrative problems which a committee may present to him. In matters of discipline and the allocation of duties among the medical staff the medical administrator has a distinct advantage.

Medical Staffing. Most municipal hospitals have now appointed full-time surgeons or physicians to their staff. This is contrary to the traditional voluntary custom of having a consulting or visiting staff, the latter usually consisting of the most skilful doctors in the locality. Consulting practice still tends to attract the best in the profession, and it might be argued that, by appointing full-time consultants, the best medical service in the locality is not available for the patient.

Up to the present time the medical staff of municipal hospitals has not been augmented by the services of young doctors in residence, commonly known as "housemen." There is, however, a growing tendency in the municipal hospitals to follow the voluntary hospital practice and appoint part-time visiting consultants in addition to the whole-time medical staff.

In the voluntary hospital visiting staff are practically always part-time visiting consultants except in the case of the large teaching hospital, which in some cases appoints a whole-time professor of surgery or medicine in order to facilitate his teaching work as well as his clinical duties. In the larger hospitals there is the resident medical officer, who is a step below the part-time visiting staff and is generally in charge of the housemen, and may hold his appointment annually for a period up to four or five years.

Matron. The present tendency is to take away from the matron all sorts of household and catering duties, which are now being put in the hands of experts, leaving the matron free to concentrate on the provision of an efficient nursing staff, the proper carrying out of their duties, training of student nurses, and all the matters on the matron's side which pertain to the comfort of the patients.

She should be provided with adequate technical, educational, and secretarial staff. She should be encouraged to study in practice and by enquiry the nursing needs of the patient, on the one hand, and the needs of the nurses on the other, so that new methods and standards of nursing may be kept constantly in mind throughout the hospital.

Almoner. Originally almoners were introduced to check the abuse of charity by enquiring into the circumstances of the patients, and the abuse of the free services of the honorary medical staff. As far as municipal hospitals are concerned this appointment is a somewhat new feature. A municipality has a legal obligation to recover as far as possible the cost of treatment from patients, and, of course, it can sue for fees. Despite their powers, most authorities have wisely left the assessment and the collection of fees to the almoner. This officer is able to help patients in many directions, and the grateful patient is thereby likely to contribute more than he would by legal enforcement. This is a new spirit in municipal administration, and there are many officials who do not agree that it is preferable to the collector system of public assistance departments. The almoner system has been in existence in voluntary hospitals for many years, and the municipal authorities have to thank voluntary hospitals for showing them what is possibly a better and more remunerative method. Upon the establishment of contributory associations it was one of the privileges of the contributors that they were

exempt from enquiries by the almoner. The contributory association is responsible for seeing that the income of its contributors does not exceed certain agreed limits, and therefore the function of the almoner has increased in scope and importance, but it should be remembered that the duties are mainly concerned with social services. The almoner undoubtedly began as an assessing officer, but the emphasis on the social welfare side of her work continues to grow and under the National Health Service is likely to become paramount.

Most of the work of this officer is in the out-patient department, where she must be in close touch with the records office, for not only does she enquire into necessitous cases with a view to aid, but also finds out whether patients can afford to and should pay something for their treatment. She also has after-care duties.

Housekeeper and Steward. In a small hospital the housekeeper often acts as steward also, and therefore has the control of deliveries for the kitchen in addition to the supervision of the maids and their work. In a large hospital she supervises the work of the maids only. She is provided with her own office.

The steward works under the direction of the chief administrator and is principally responsible for the central stores and general administrative duties. The steward in a municipal hospital is nearly always supplied from a central contract, whereas the steward in the voluntary hospital is responsible for buying direct in the open market.

PLANNING

The administration department should be sited so that it is readily accessible from the principal public entrance. The entrance to this department is often referred to as the "main entrance" on account of its prominence, but this customary treatment should be abandoned. The impression that this is the only entrance must be broken down, as the out-patients entrance for example, is just as important. The administration department may be regarded as the central nervous system of the hospital. It should be centrally situated so that the lines of communication with other parts of the hospital may be as short as possible. Much depends upon the planning of this department, which should be such that it may function smoothly and efficiently.

The accommodation will consist of offices for the administrator and for the departmental administrative heads, secretarial, and for the departmental clerical offices, etc., reception rooms for hospital functions, and suites of rooms for the resident doctors, the matron, and for the chaplain, and a board room, while an ante-room might form a separate committee room. It will be appreciated that the requirements of the office accommodation for a hospital will be modified according to the special circumstances, and therefore the recommendations contained in The Report for a four hundred bed acute general hospital will be given as a guide. The units considered necessary are:

a committee room and offices for administrative officers and clerks
b waiting accommodation for patients' friends

c cloakroom and sanitary accommodation for staff, etc.
d central stores
e central kitchen
f dining-rooms for resident and non-resident staff of different grades
g quarters for the matron and resident medical officers.

Comments on (*a*) to (*c*) are contained in the paragraphs which follow; on (*d*), (*e*), and (*f*) in Chapters 8, 9, and 10 respectively; and on (*g*) in Chapter 11.

Fig. 8 indicates the administration department of the Royal Masonic Hospital, a two-hundred-patient hospital. This is an elaborately planned department and should not be taken as a guide for a hospital with limited financial means.

In planning this department, it is useful to bear in mind the following general principles governing the relative positions of certain departments and providing economy in planning as well as convenience and economy in administration:

a the offices of the chief administrator (or medical superintendent), the matron, and the steward should be near the entrance, as persons from outside the hospital need ready access to these units without disturbing the general internal working of the hospital;
b the living accommodation for house surgeons, matron, and possibly maids can be placed away from the entrance and on upper floors, but easily accessible from the main corridors;
c the central stores should be situated in convenient relation to the central kitchen;
d the dining-rooms and service rooms have to be situated for easy and rapid access for the serving of meals from the central kitchen.

ACCOMMODATION

Porter's Lodge. It is the porter's duty to answer enquiries, keep records of visitors, direct authorised callers to their destination in the hospital, generally to control the ingress and egress of patients, visitors, and staff, and to undertake such other duties as may be imposed upon him by the chief administrator.

The porter's lodge needs a twenty-four hour service and should be staffed by non-residents except in very small hospitals, when the porter is provided with a two- or three-bedroom house.

The entrance to the hospital grounds is commonly controlled from the porter's lodge, but economy in staff results if a separate porter's lodge can be dispensed with and the enquiry office and telephone exchange located in the administration department. This may not always be possible or desirable, but when it can be achieved, an enquiry office combined with telephone room, opening off the main entrance, will be provided. The lodge when situated at the entrance to the hospital grounds is always given full sight over the entrance gates, as here the traffic is supervised and separated according to function—ambulances, out-patients, visitors, hospital staff, and students, service and delivery trucks.

The switchboards of telephone systems usually incorporate the fire-alarm system, and must therefore be easily visible on entering the room. It is customary to have two telephone systems, one for internal use between all departments of the hospital, and the other, the Post Office system, with extensions to departments such as the offices, central kitchen, central stores, and casualty departments, which may need direct communication outside the hospital.

When the hospital exceeds three hundred beds, the telephone traffic is usually so heavy that it is preferable to put the switchboard in a separate room, not accessible to the public but sufficiently convenient to the information clerk to enable a single clerk to attend both during the night or other slack hours.

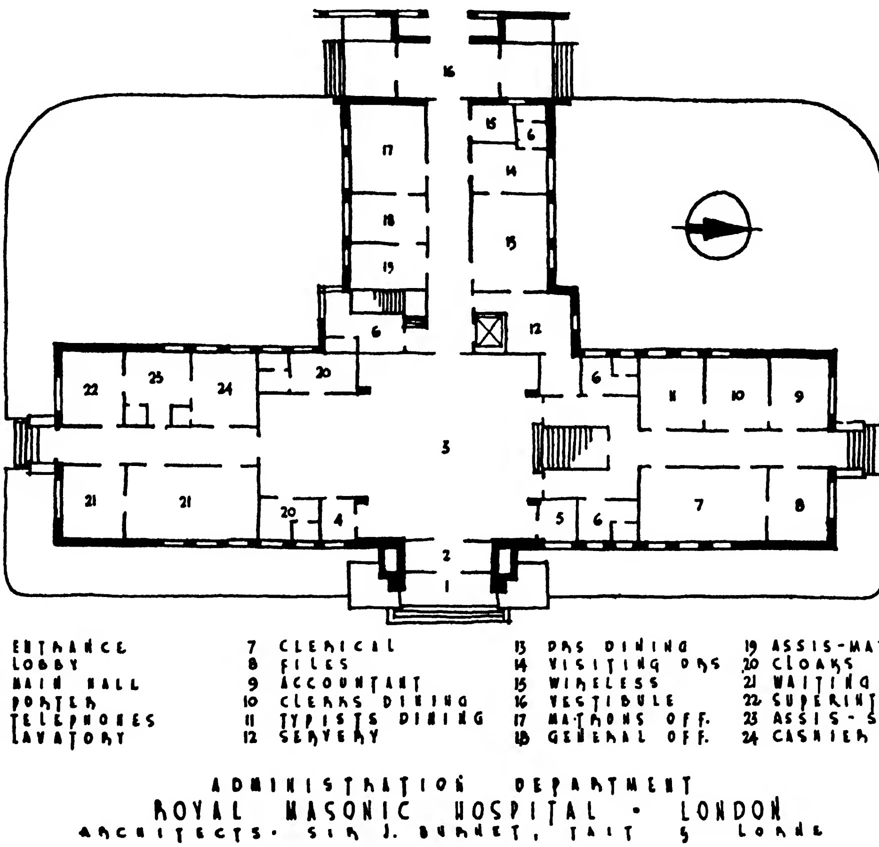


FIG. 8.

Entrance Hall. This should be of adequate size, and from it on either side the circulating corridor extends. The hall may contain:

- *a* a telephone room for official use
- *b* Post Office telephone kiosk for the use of visitors and for private calls by the staff
- *c* a post box.

A shop where cigarettes, shaving soap, hairpins, cosmetics, etc. are sold, is a convenience to the public and staff and a source of income to the hospital.

Chief Administrator. Offices as follows:

a private office
b clerks' office
c a room for visiting medical staff.

A fire-resisting enclosure for irreplaceable documents will suffice for a "strong room," a burglar-proof strong room being considered unnecessary.

In a voluntary hospital the record room containing the records of patients—which include literally hundreds of thousands of current notes of out-patients—is an extremely important sub-department either of the almoner or of the registration clerk; several staff may be employed here.

The medical staff room is used by the doctors who are not resident in the hospital but who make daily or occasional visits. The room should be a fairly large one, so that it may be used as a medical library or for consultations, and an area of 300 sq. ft. should be allowed. Directly attached to this room should be placed a lavatory, with lockers for the visitors.

Matron. Offices as follows:

a private office
b office for assistant matron or clerk.

The private office should be placed near the chief administrator's office and at the same time as centrally as possible in relation to all departments of the hospital. The rooms should have an area of at least 200 sq. ft. each, and the assistant's room can also be used as the night superintendent's office.

The matron's living quarters may often be in this department, and when so it is desirable that they be on the first floor above, with a separate internal stairway leading from her office suite. The accommodation given to her is reviewed in Chapter 11.

Steward. Offices as follows:

a private office
b general office.

A burglar-proof strong room is needed by the steward for hospital cash and for the jewellery, etc., of the patients.

Almoner. Offices as follows:

a private office
b general offices
c waiting-room.

The work of this officer is likely to increase, particularly in connection with the out-patients department, and therefore adequate provision should be made for the extension of this unit. Generally, a fairly large area is needed, as considerable filing space for records is often required, as well as space for interviewing patients or their relatives. Her offices must be related to the out-patient department, the same as the dispensary, to provide circulation.

The almoner in the voluntary hospital has nothing whatever to do with appeals; she is solely concerned with matters relating to patients' contributions, patients' notes, and social welfare. The appeal organisation is entirely separate, and is usually under the general direction of the chief administrative officer.

Committee Room. A room for the meetings of committees and other bodies is a convenience that is sometimes regarded as superfluous by people not in intimate touch with practical needs. In the case of the large voluntary hospital the board-room and a subsidiary committee-room are tremendously important and in very considerable use for the various committees. The rooms should have a floor space of about 22 sq. ft. per person, in order to allow for comfortable chair spacing and adequate circulation space. The board-room is normally attractively finished; as an example, it can be constructed with a dado of Australian walnut, furniture of the same material upholstered in green hide, and a fireplace in Swedish green.

These rooms are an unnecessary extravagance if used solely for a monthly or even weekly meeting. Any rooms provided should be usable for some other purpose as well.

Waiting-room. This is a general waiting-room, which will serve for candidates for appointment to staff, persons waiting to see the chief administrator or the matron, etc.

Patients' Friends Waiting. Whereas the previous waiting-room is for office administration, waiting accommodation must be provided for the relatives or friends of patients who are dangerously ill or who are undergoing an operation. The minimum requirement is a comfortable, warmed room with easy chairs, but it is sometimes considered necessary to provide couches and a canteen for people who have to wait for a long time. The lighted recess in the ward block or a room attached to each block of wards is most convenient, as the accommodation must be readily accessible to the ward in which the patient lies.

Covered waiting accommodation for patients' visitors assembling on ordinary visiting days is also required, but The Report stated that as a rule this would not be in the administration department. It should be near the principal entrance and should be so situated as to give ready access to the wards.

In some hospitals use is made of the out-patient department for this purpose on Sundays and other days when it is not open for treatment. In recent years there has been a great increase in the numbers of patients' visitors, and the problem which their

accommodation presents is difficult to solve. The Report stated that, while they recognised that on visiting days the stream of visitors is considerable and that some waiting accommodation is required for them, they consider that in the interests of the patients themselves as well as in the interests of general convenience and economy in planning, the number of visitors per patient should be strictly limited, and that suitable administrative measures should be taken to enforce this rule. It must be remembered that even if the number of visitors is limited to two per patient, in a four-hundred-bed hospital this would mean eight hundred people coming to the hospital to see their patients approximately during a period of one or one-and-a-half hours.

At the Southern Hospital in Stockholm the entrance hall is of huge proportions. It holds about two thousand people, which number represents the estimated maximum of visitors to the patients. This hall is provided with a post office, a café, a paper shop, a tobacconist's, and a flower shop; it also has a crèche for children, with a nurse, where visitors can leave their children. Another practical arrangement for the visitor is that the corridor leading to the ward he is to visit is painted in the same colour as his admission card.

Sanitary Facilities. Cloakroom and sanitary accommodation is required for the clerical staff. In the past separate sanitary provision has sometimes been made for each of the principal officers, but this is unnecessary, and with careful planning the requirements of these officers can in most cases be met by two cloakrooms, one for each sex. Separate sanitary accommodation for non-resident staff is not generally necessary, as it should be possible for them to share the accommodation provided for the appropriate resident grades.

Further sanitary accommodation is necessary for the male clerical staff, porters and male domestic staff, female domestic staff and nursing staff—in connection with the dining-rooms—and this last group will also serve the needs of the female clerks and assistants in the laboratory, dispensary, etc.

Cloakrooms, fitted with long lockers, should be provided for non-resident male and female nursing staff and non-resident male and female domestic staff. This need is often inadequately met, but accommodation can be quite satisfactorily provided in the basement, thus saving valuable space on the ground floor.

Separate sanitary facilities will be provided for patients' friends adjacent to their waiting accommodation.

Records. A storage need, often not provided for, is that for old clinical records. These records accumulate rapidly and while apparently there is no legal requirement that such records shall be preserved indefinitely, hospitals generally feel that they should be preserved for the benefit of the patient in future illness and for the protection of the hospital and the doctor in case of legal action. The American practice of filming records has reduced the storage space requirement by at least 98 per cent. for such records as are micro filmed, but common practice then is to micro film only those records which

are more than ten years old, thus leaving on hand at all times at least ten years' accumulation of original records.

Storage must likewise be provided for such X-ray films as it is desired to preserve; formerly it was necessary to provide a special type of fireproof storage for films, but the type of material now used for X-ray films is of a combustibility comparable to that of grocer's paper and its combustion is free from dangerous gases. It does not require any storage precautions beyond those required for other paper records.

Chapel. While, with very few exceptions in the past, no specific provision has been made in the hospitals for separate accommodation to provide for services of all religious denominations, every possible facility has been afforded for the holding of such services. The size of these chapels and the nature of their equipment varies, of course, with the accommodation possible, the number of staff and patients who can attend, and, as far as the staff are concerned, the proximity of neighbouring churches.

A room with an area of about 800 sq. ft. should be suitable for non-denominational devotional purposes, with a small chaplain's room in close association. If a chapel is not provided, a small devotional room into which staff, patients' friends, and ambulant patients can go for a few moments for private prayer and a chaplain's room will always be provided.

Library. Patients' libraries, that are more than just a stock of magazines and occasional gift books, are now generally recognised as a valuable unit of any hospital service.

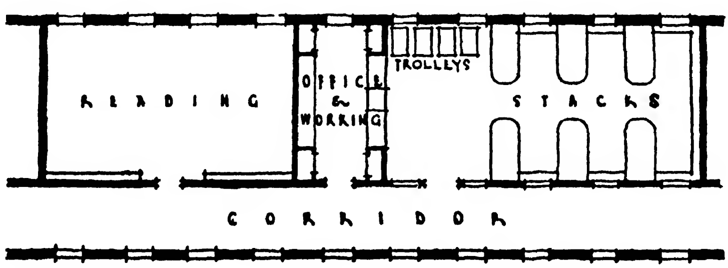
In general, the library consists of a stock room with its necessary equipment, from which the books are distributed to the wards by means of trolleys. This is a minimum that is all too often met with makeshift accommodation; the aim should be the provision not only of a stack room but of a habitable reading-room for those patients who are fit enough to use it (see Fig. 9). This is a counsel of perfection for the general hospital, but it should be regarded as indispensable in mental hospitals and sanatoria, where the relief obtained by quietness and a change of surroundings is of particular value.

With the general tendency of thought towards a more human atmosphere in hospitals and the knowledge that the treatment of illness and disease must concern itself with more than its physiological aspects, an efficient library in the charge of a trained librarian should be regarded as an essential part of the equipment of any hospital organisation. The central supply of books should be augmented by shelves in each ward or in the lighted recesses, for books which can possibly be changed once per week and to which the patients can have free access.

The administration of the central supply may vary with different types of hospital; there may be special libraries for infectious cases, under the control of the central administration; in hospitals for infectious diseases the distribution of books will be under the control of the nursing staff, and books will be constantly burnt; in large

establishments with scattered pavilions—a condition often met with in mental hospitals and sanatoria—it may be necessary to have a central library containing the main stock and index, and subsidiary libraries in each pavilion, fed from the central library. Another variation is when, in a large hospital, the patients' library and the medical library, though kept apart, are under the same administration, and where the hospital staff makes use of the patients' library and patients are allowed to come to it. But whatever the type of hospital and whether it is planned on the block or pavilion system, a central stock is necessary.

It is difficult to estimate the number of books per bed that is required. The minimum advocated in Great Britain by the Guild of Hospital Libraries is three books per bed, and it seems highly desirable that, in the planning of new libraries, this figure and nothing lower should be taken as a basis. Special books, such as those in Braille or in foreign languages, should be additional to this figure, and, whenever possible space should be allowed for expansion. It should be remembered that hospitals with long-



LIBRARY
TYPICAL LAYOUT
FIG. 9.

standing cases, such as mental hospitals, sanatoria, and orthopaedic institutions, need space for a larger number of books than general hospitals, because a much wider selection is required.

The position of the library will naturally depend on the particular requirements of the hospital which it serves, but the main influencing factors are accessibility to the majority of the wards served, proximity to lifts—for trolleys—and accessibility, quietness, and good orientation when it is planned in conjunction with a patients' reading-room. It should be placed outside the main stream of circulation within the hospital.

Although the library room may include space for a reading-room for walking patients, the basic requirements of the stock and working space will probably not be materially affected; for it seems best to plan for two independent zones, allowing patients to walk about in the stack space, but, while they are sitting and reading, relieving them of the inconvenience and distraction of having library assistants with trolleys moving amongst them, unloading and loading books to and from the shelves.

The planning of the stack space should allow enough room between and around the

stacks for easy circulation of trolleys, space in which to park the trolleys when not in use, and working space for the library assistants, who, besides loading the trolleys, distributing the books to the wards, and returning books to the shelves, need facilities for cataloguing, mending, and sorting. Such a working space can be efficiently and economically equipped—as it is in the Middlesex Hospital, London—by wooden, counter-height tables for the card index, cataloguing, and mending, etc., with shelves and cupboards under for tools, books needing mending, discards, new acquisitions, etc. Since books are dirty things to handle, a sink or lavatory basin should be provided if there is no washing accommodation near the library, and, the librarian's hours being long, a gas ring for making tea is desirable. A hanging cupboard is necessary for librarian's coats and locker for personal belongings if possible.

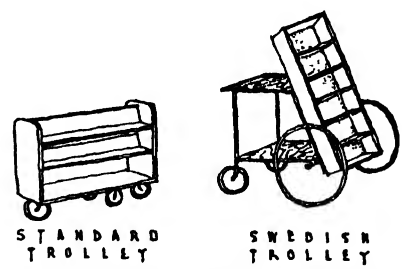


FIG. 10.

Book trolleys are essential for any efficient library service (see Fig. 10). The number of trolleys depends upon the number of library assistants and whether they work in shifts, but five trolleys for five hundred beds, or about four hundred readers, can be taken as a rough guide. Allowance should be made for the possibility of more trolleys than this, for it has been estimated that the adequate running of a library requires one assistant to every sixty reading beds.

The patients' library may be used as a social workers' room. This unit, which may with advantage be near the Almoner's unit, is also used by voluntary workers who visit the hospital to provide recreative, educational, and occupational facilities for the patients.

DOMESTIC QUARTERS

Special consideration should be given in each hospital to the way in which domestic work is carried out and the full use of labour-saving devices should be encouraged. The Ministry of Health have appointed specialist officers whose services are placed at the disposal of any hospital needing advice on this matter.

The Ministry of Health memorandum "Staffing the Hospitals" (1945) states the standard of accommodation which should be aimed at for all resident staff in all hospitals as follows:

a single bedrooms, properly decorated and furnished according to modern standards with adequate ventilation, heating and lighting, a comfortable armchair and if possible a fitted basin and with hot and cold water laid on; where fitted basins cannot be provided in the bedrooms there should be a readily accessible and adequately equipped toilet room curtained off into cubicles;

b adequate bathing and lavatory arrangements;
c shampoo rooms and facilities for the washing and ironing of small articles;
d bed-sitting-rooms for senior domestic staff;
e sitting-room with wireless set and equipment for indoor games, e.g. table tennis, etc.;
f a room for the reception of guests of both sexes and cloakroom for guests.

The accommodation for domestic personnel is also referred to in Chapter 11. As stated there, the accommodation can form part of the nurses' home, but it is preferable if they are kept apart, and therefore accommodation on the upper floors of the administrative department is very suitable.

They should be conveniently placed for easy access to the central kitchen, and the sitting-room placed for easy access to this kitchen and maids' dining-room. The sitting-room should have a pleasant outlook on to the gardens, if possible, and a western aspect, as it is mainly used during the latter part of the day. The area of this room should be based on an allowance of 12 sq. ft. per person.

The bedrooms should have an area of at least 100 sq. ft. per person, with a built-in wardrobe and dressing table. It is considered by some authorities more economical to provide a large lavatory unit, as the cost of providing basins in each bedroom is considered too great, but see Chapter 11 on this question. Lavatory basins should be provided at the rate of one to four persons, exclusive of any that may be placed in the bathrooms. It is more satisfactory and greater privacy is gained if the basins are placed in small cubicles with partitions of wood or metal, with a curtain to close the entrance to each compartment. The partitions should be at least 3′ apart, and should extend from about 6″ above the floor level to a height of 6′ 6″, the floor clearance being to facilitate washing down.

W.Cs. should be provided at the rate of one to six persons. They should be grouped together with a housemaids' closet and incinerator, and placed as centrally as possible. Other necessities are hair-washing cubicles, laundrettes, box-rooms, etc., which are reviewed in Chapter 11; these are also applicable to this department.

Senior members of the domestic staff (i.e. housekeeper, cook, and laundry supervisor) should have bed-sitting rooms or flats consisting of sitting-rooms and bedrooms with a total area of about 240 sq. ft.

For non-resident staff there must be adequate toilet and cloakroom accommodation and facilities for meals or refreshments during the day.

7

The Central Power-house

THE QUESTION whether steam or hot water required for heating should be generated in a central power-house or in independent boiler chambers for individual blocks or groups of blocks is a matter which must depend largely upon local conditions. It will generally be found, however, that although the capital cost is definitely higher, a central power-house is more economical in operation and more convenient.

Generally, a central power-house, though entailing greater capital cost, would have the following advantages:

- *a* the type of plant to be installed would be more economical in operation and in fuel consumption, and a cheaper class of fuel could be used;
- *b* labour costs would be lower, as there would be less staff required and less cartage of fuel or ashes to or from the different blocks;
- *c* the noise and dust created and the wear and tear of roads and vehicles involved by such cartage would be avoided;
- *d* there would be better regulation of the temperature in both heating and hot water services and better supervision of the labour staff;
- *e* interruption in the supply due to a breakdown of any one unit would be avoided, as duplication could be provided at a reasonable cost, whereas, in the case of local generation of heat, duplication by stand-by boilers in each building would be extravagant;
- *f* basements and flues in each block would be unnecessary;

PLANNING

The central power-house will contain the main boiler-room (see Fig. 11) and the ventilation and electrical controls for the whole group of hospital buildings. In planning this block, the plant must be decided upon before the building is designed.

Heat for all purposes is generated here and because, unlike a factory or office building, a hospital never closes down, in planning the power plant it is always advisable to provide for duplication of units sufficient to protect against interruption of service by failure of any unit and for the periodical overhauls necessary for boiler cleaning, etc. Thus if the indicated load calls for a maximum of 100 h.p. it is well to provide three 50-h.p. units, one for low-load periods, a second for peak-load seasons, and a third for stand-by. Peak loads are usually of relatively short duration and the

manufacturer's ratings of boilers are usually so much below actual steaming capacity that any boiler in good condition can be operated at as much as 50 per cent. above rated capacity for short periods of time without injury. In the hospital the peak load lasts only about 6 or 7 hours per day—laundry hours. Thus for a peak load of 75 boiler horse-power two 50-h.p. boilers would be adequate, as either operated at 150 per cent. of rating would meet the peak demand and operating one boiler at rating or below would carry the off peak load without difficulty and leave the other in reserve.

Whether such reserve capacity is installed or not, the space should always be provided for both the reserve and any added boilers any reasonable expansion of the hospital may need. The relatively few extra square feet of space will represent but little expense if provided for in the original building, but if not so provided for, future expansions may require extensive and expensive alterations to the entire power plant area.

Hospital buildings are normally heated by either low-pressure hot water or steam. The hot water in the warming system is heated in calorifiers by steam from the main boilers and in the same manner water for the hot water supply is heated in other calorifiers. Low-pressure steam is distributed where necessary into the various units for sterilising and cooking, and steam mains are available at a high pressure for special sterilising apparatus. Where steam is generated for all services and when hot water radiators are installed, the steam required for heating and hot water is passed through calorifiers, which when concentrated in the central power-house, reduces their number and consequently their cost, but it has the disadvantage of involving the use of larger pipes which are necessary when water is distributed than those that are required where only steam is distributed. Six pipes are normally necessary—some of them of large diameter—the flow and return for hot-water supply, the flow and return for heating, and possibly a small steam flow pipe and condensation return. A consideration affecting the decision whether local or central calorifiers are to be installed is the calculated loss of heat that may take place in the duct between the central power-house and the department to be heated. Although steam pipes are of smaller diameter than the hot water pipes, they are worked at a much higher temperature, and therefore the loss of heat per unit of service is greater.

The general opinion expressed in The Report is that the most economical and efficient arrangement was to place the calorifiers in the central power-house; this provides better control and regulation of the temperatures, permits a closer supervision of labour, with consequently lower maintenance costs, and produces a better all-round efficiency.

In small installations it may be found to be more economical to provide hot-water boilers for heating and hot water and steam boiler for the laundry, central kitchen, and other purposes. The boilers for heating and hot water might be interchangeable, with a single stand-by for the two services.

Where independent boilers are installed in each block or group of blocks, the conditions in the preceding paragraph will reign, and each chamber should therefore be large enough to accommodate three boilers. If in these independent schemes the boilers

are placed in a chamber below the level of the ground-floor of the building, it will often be possible to operate the system by gravity. By this means the installation of pumps will be avoided, but larger pipes will be required. Where levels allow, two or more adjacent blocks may be served from one such chamber. This is particularly desirable in the case of a first instalment of a large hospital layout where it is intended eventually to supersede these separate boilers and to connect each block to a system of underground ducts and obtain heat from a central power-house. In such a case it is desirable so to lay out the runs of mains that they can still be used in the event of conversion to a centralised scheme. As this conversion involves the abandonment of the separate boiler chambers and their entire equipment, the number of separate boiler chambers should be as low as possible. To this end the buildings of the first instalment should be in close proximity to one another and complete centralisation should take place as soon as development has sufficiently progressed. If steam is required for sterilising in any blocks which are independently heated, this should be supplied from a steam boiler at the laundry, if available, or otherwise by means of gas or electricity.

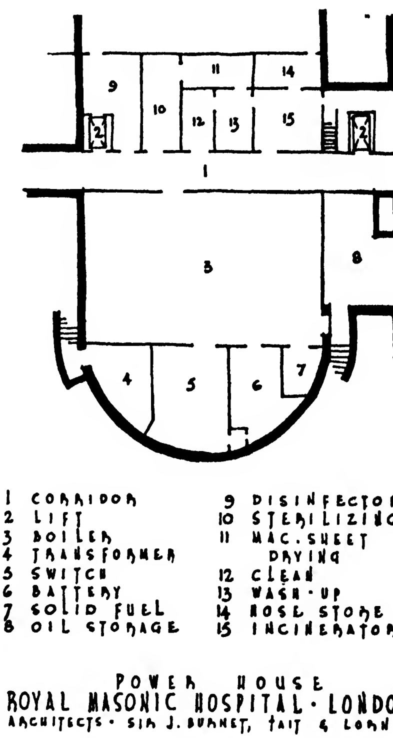


FIG. 11.

The particular arrangement to be installed in any hospital must depend largely on the local conditions, and is a matter for close and careful consideration by the engineer. When the hospital consists of a group of buildings situated close together the advantages of centralising the boiler plant are obvious; but where, as in the case of an isolation hospital, it comprises a number of scattered buildings, some of which may perhaps only be occupied intermittently, the question whether each block should be independently heated requires careful consideration.

At the Royal Masonic Hospital, London, the plant comprises economic type tubular boilers equipped with automatic oil firing, together with the necessary vacuum pumps and boiler-feed pumps. Here the heating services are on the water vapour principle, and the system is designed to allow any main or sub-main section of the building to be isolated. The whole of the condensation from the heating services, together with that from the services to cooking, sterilising, and air-conditioning apparatus, is drawn back to the boiler room by means of vacuum pumps and discharged into a well for boiler-feeding purposes.

Where all the heat required for heating and hot-water services is generated in a central power-house, the siting of this building is important. Owing to the noise and

dust caused in handling fuel and ashes, it should not be too close to ward blocks, but should be as centrally situated as possible and in convenient relation to the laundry and central kitchen so as to avoid long runs of steam mains. The level contours of the site will also have to be borne in mind particularly if steam is to be passed to the different units and its condensate returned to the boilers. If the levels permit the power-house can well be placed at a somewhat lower level, thus improving the circulation of the various pipe lines. The steam or hot water required can be circulated by either gravity or pumping.

The power-house should be placed so that the prevailing wind, usually from the south-west, will carry smoke away from all other buildings on the site and should be at such a level that excavation is reduced to a minimum to obtain the necessary falls for service pipes. The position should be determined by the architect in collaboration with the consulting engineer, and the design of plant left to the engineer, who usually has particular ideas as to the power-house and workshop requirements and the housing of the various plant. The diagrammatic sketch (see Fig. 12) indicates the essential circulations necessary.

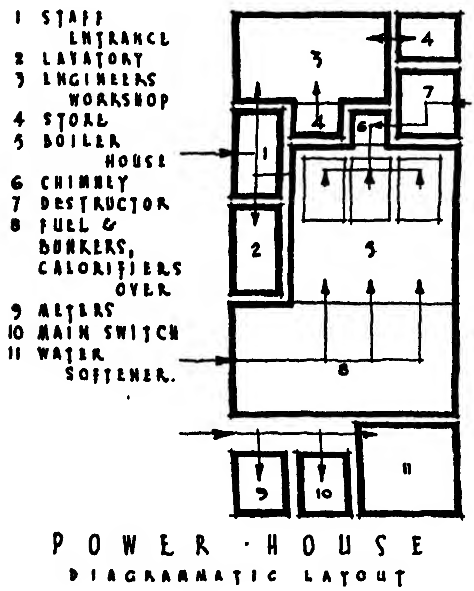


Fig. 12.

Deliveries from outside the hospital, such as plant and fuel, should be on the side away from the principal units in order to leave the other side clear for the destructor and pipe ducts to the various units and to avoid dust and noise from deliveries.

Subways radiate from the central power-house. In these are run the pipe mains, also electrical work of every description.

The destructor will be combined with this block for disposal of refuse.

ACCOMMODATION

Bunkers. The size of the fuel store is dependent on the most convenient quantities of fuel to be delivered at any one time. If solid fuel is used, the bunker levels should be carefully related to that of the delivery road to avoid excessive handling and arranged so that the fuel is tipped directly into them from lorries without hoisting; it should then fall by gravity to the points from which it is shovelled into the boilers or fed into the automatic stokers—the latter may need high-level bunkers.

Conditions control the storage of fuel; where paid labour is utilised in the handling and where annual contracts for the supply and delivery of the fuel are in force, it is

uneconomical to provide large storage space and it has been found that four weeks of the winter demand should be ample in normal circumstances. To meet any unusual emergency, such as a threatened coal strike, it would suffice if temporary arrangements were made for storing additional fuel.

Although steam coal stored in the open loses some of its thermal value, the small amount of time that elapses between delivery and use does not justify the provision of a covered store as a measure of economy, but if the fuel must be stored near the wards, central kitchen, or laundry, it should be covered to control the dust raised in the process of handling and of fly-ash, which act as a carrier of air-borne bacteria.

House-coal storage is required in addition to boiler fuel, whatever it be, and therefore an enclosed yard is needed for this and for the storage of ashes; the latter are generally removed by way of the delivery road, but should be so planned as to avoid confusion and cross circulation. This coal storage should be properly screened from the hospital departments.

Boiler House. The area required is dependent on the type and number of boilers used and the size needed for each particular unit. The type and number of boilers to be installed will depend on various factors, e.g.:

- *a* type of heating system to be provided;
- *b* whether steam is required for laundry, central kitchen, and sterilising;
- *c* whether steam required for such purposes is to be separately generated, and heat required for heating and hot-water services generated in a hot-water boiler;
- *d* whether electricity is to be generated on the site: this will be considered in Chapter 37.

The type of boiler to be used will depend on the nature of the duty required from it, and also its location and load to be carried. Boilers may be either steam-raising or direct hot-water boilers. Hot-water boilers are not manufactured in a size suitable for a large central installation, and are usually installed only in independent blocks. Steam boilers are of several types, but the fire-tube boiler is generally the most suitable for hospital work. The water-tube boiler has the advantage of quick steam-raising and can quickly respond to variations in load, but having little water capacity and therefore little reserve of heat requires more expert handling and more frequent repairs than the fire-tube boiler. Most fire-tube boilers, on the other hand, have a comparatively large water capacity and are more easily manipulated than the water-tube boiler. The "Lancaster" boiler is generally preferred owing to its reliability and low maintenance costs (see Plate IV). Although relatively less efficient and more costly than other boilers of the same class, it has a long life and is easy to manage, and its efficiency can be improved by the provision of an economiser and mechanical stoker where the amount of steam raised justifies such a course. In the case of a large hospital, mechanical stokers may be justified on the grounds of reduced labour costs and the saving to be effected by the use of lower-grade coal.

In addition to boilers, mechanical stokers and economisers, a large power-house

installation will include other equipment such as pumps, motors, and instruments of various kinds. Instruments such as meters, thermometers, and those for the measurement of carbon dioxide are most valuable and amply repay their cost in the hands of an intelligent man in charge, for economy in operating costs can be secured by the exercise of proper control and supervision in the use of hot water, and provision should be made in the lay-out for meters to enable the consumption of hot water in each individual department to be recorded.

The whole system should be designed on the simplest possible lines, each unit being selected as the best suited for the duty it has to perform. Having then selected the plant, the building can be designed. Good light, preferably from windows, is an advantage; the chimney shaft should be close to the boiler-house and destructor; doors should be large to permit the removal of a boiler or sections of a boiler according to the type used; and an overhead track and hoist for handling of ashes should be provided.

Workshops. These shops are used for minor repair work in connection with all engineering plant and equipment and also building and electrical repairs. Good light is essential.

The engineering and building trade workshops should comprise fitters', carpenters', painters', and wiremen's shops, a mess-room, sanitary accommodation, and a suitable lock-up store for materials and spare parts. A wash-basin should be installed in each shop and there should be a spray bath in the boiler-house for the stokers' use.

The equipment of the fitters' shop should include power-driven lathe, drilling machine, pipe-screwing machine, pipe-bending machine, and forge, and in the carpenters' shop a foot treadle lathe and morticing machine. Proper benches and tool racks will be provided as appropriate.

It is obvious, the more complete the tools, machines, and similar accessories provided, in reason, the more service and salvage of still usable equipment can be expected.

Office. A room of about 80 sq. ft. in area is needed as an office for the engineer in charge of the plant. It should be planned to overlook the boiler-house.

Meter-Room. A small room near the engineer's office is needed for the meters, and attached to it should be the main switch room. The meter-room needs no special fittings or equipment.

The gas and water meters are frequently placed in a small building near the entrance to the site, if the boiler-house is not at the road side.

FINISHINGS

The walls of all these rooms are satisfactory if executed in fair-faced brickwork; granolithic paving is the most satisfactory floor covering.

Some power-houses have walls lined with tiles. This is not essential, but gives a very pleasing finish, and more so if the lagging to the various service pipes is painted a different distinctive colour.

8

The Central Stores

THESE STORES are an important department, which is not often given the consideration it deserves in the planning. The space allotted is often inadequate, with the result that the store-rooms are overcrowded and inefficient. They should be of such a size that all the commodities are easily accessible and easy to supervise, thus lending to economy by the elimination of dead stock buried in overcrowded store-rooms.

Much has been written concerning the purchase of supplies in the hospital. But there is far more economy possible in proper control of the use of supplies after purchase and receipt than there is in even the most skilful purchasing! Likewise good purchasing is more dependent on adequate records of rates of consumption and on cost of supplies per unit of use than it is on mere negotiation on price and terms.

Complete control of all use of supplies and accurate data on consumption rates and the cost per unit of use can be obtained only by a central receiving, issuing, and stock-accounting procedure. This means in effect a central general store-room. This department receives all incoming consignments of goods, checks delivery invoices, stores the goods, issues to the using departments upon properly authenticated requisition and maintains a perpetual inventory.

This department may handle not only current ward, nursing, and similar supplies, of whatever nature, except perhaps fuel, but including raw foods in bulk for daily or at least periodic issue to the kitchen. The overall general principle is that the more completely the store-room is in control of the receipt, storage, issuance, and accounting for supplies, the greater will be the economy, because every user of supplies will be made to realise that everything he uses is charged against his department.

These stores are chiefly under the control of the steward and his store-keeper, but in the hospital of one hundred beds or less there is rarely sufficient work to justify a full-time store-keeper or a full-time pharmacist. For this reason it is sometimes feasible to place the dispensary adjoining the issue section of the central stores and to engage a pharmacist as both pharmacist and store-keeper, the combination giving a large enough amount of work to justify the salary it is necessary to pay a competent combined pharmacist and store-keeper. The well-trained pharmacist is likely to be a good buyer, a good stock-keeper, and at least a fair executive. Giving such a person full responsibility for both functions and supplying him with enough facilities and assistants to permit him to discharge his responsibility fully is likely to produce better results than can be expected from any part-time arrangement. Ample space must be provided for organised

storage, with the necessary office or offices and their ancillaries, the receiving or unloading platform, distribution counter, lifts, etc., and in a large scheme a weigh-bridge will be installed.

See Figs. 14 to 16 for examples of recent stores, and Fig. 15 for a typical layout.

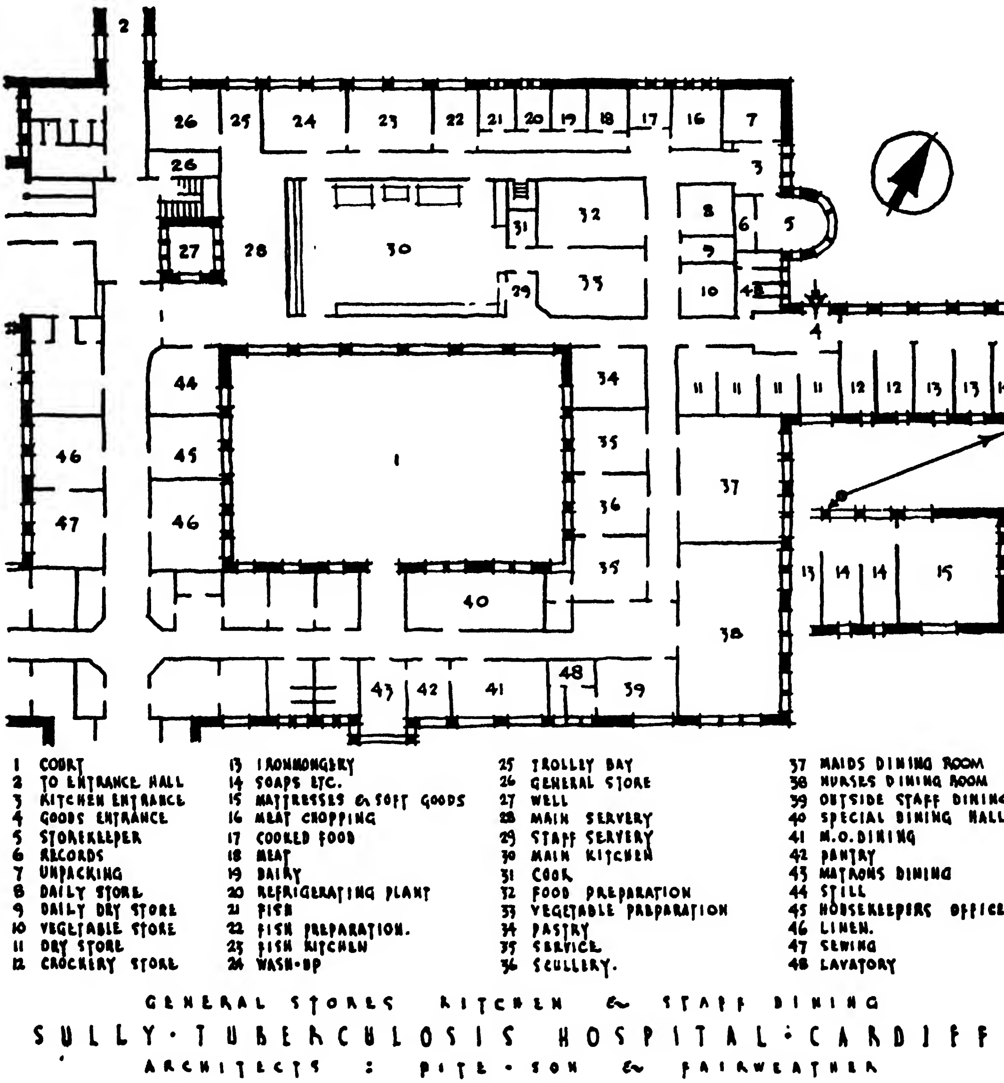


FIG. 13.

PLANNING

A central position for these central stores is essential for issuing to the wards and the various departments, and the store-keeper unit must be situated within the department.

This unit should be near the central kitchen service courtyard, as all goods coming into the hospital should come under the supervision of this officer. The receiving docks and the entrance from the receiving dock should be conveniently arranged so as to facilitate the handling of large or unwieldy containers. Convenience to lifts and other means of internal traffic is less important than convenience to and control of incoming traffic, i.e. deliveries. This is for the reason that incoming traffic is under virtually no control, while internal traffic is for the most part under complete control.

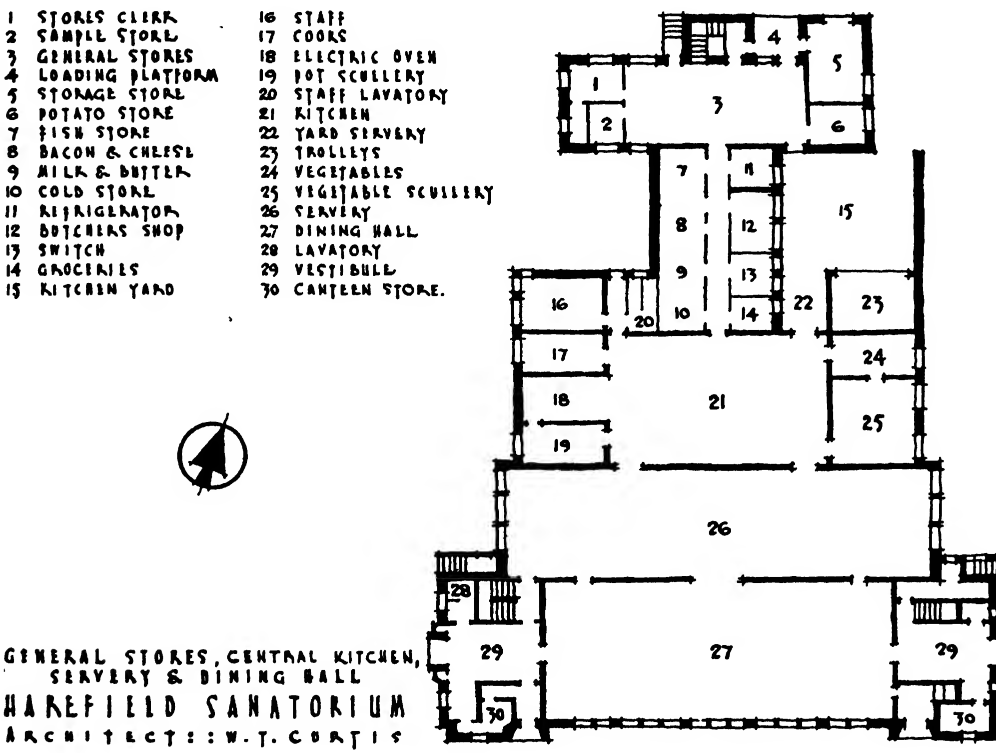


FIG. 14.

The unpacking room should be adjacent to the store-keeper's office; and other rooms, for empty packing-cases and empty bottles, should be attached to or placed near the unpacking room. These rooms are a great convenience, for they reduce the disorder and muddle around these units.

With regard to the textile, clothing, and bedding-stores, and the drug-stores, the tendency nowadays is to decentralise the control of these goods by placing the linen under the control of the matron and the drugs under the control of the pharmacist. The drug-store should be placed as near as practicable to the dispensary.

The provision for food should be atmospherically separated from that for other articles, and should include adequate cold storage accommodation.

The stores will therefore be grouped under various categories, and will normally consist of the following units:

a engineer's stores, so far as they are not under the control of the engineer;
b crockery of all kinds;
c domestic appliances and cleaning materials;
d hardware;
e textiles, clothing, and bedding;
f dry food, such as tea, sugar, cereals, flour, etc.;
g milk store and distribution room, with provision for washing and sterilising milk pails;
h butcher's shop and meat and food store;
i vegetable store;
j etc., etc.

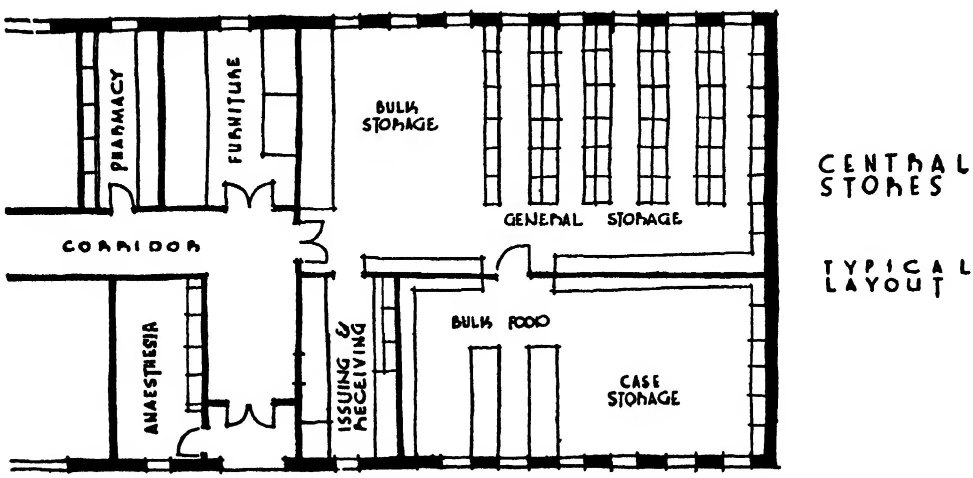


FIG. 15.

In addition to the storage of supplies handled by this department there is a definite need for space for the storage of surplus equipment such as extra beds and furniture, summer storage of blankets and similar items which inevitably accumulate and must be stored against time of future need.

Lifts may be necessary in stores of more than one storey. When provided, these should be of the automatic push-button type without self-levelling device.

ACCOMMODATION

General. There need be no particular provision for a waiting area—as it is much more economical to provide a delivery service than to permit the various personnel of the hospital to bring their requisitions to the store-room and wait for them to be filled.

The number of different items carried in the goods store-room will seldom be less than one thousand, while the more complete store-room required by the larger hospital may approach three times that number. This emphasises the importance of careful planning of at least the issue section.

The space required of course varies with the completeness of the service it is expected to render. It may require, as little as 5 sq. ft. of floor area per bed or if it handles all incoming supplies including food it may require as much as 20 sq. ft. per bed. For convenience of operation it is advisable to divide this space into two sections, not necessarily connected. One of these is for reserve storage for original packages received. The other is the "live" stock. By using the two sections the size of the "live" or issue section can be much smaller than if both are together. Actually each of the two sections will usually be of about equal size. This very greatly reduces the labour required for "order picking"—as only small amounts of each item are kept on the shelves of the issue section, the stock being replenished from the reserve room as needed.

The type of equipment is simply shelving of dimensions varied according to the type of item to be stored, plus a small office area for the store-keeper's work and records, and a proper delivery counter or windows.

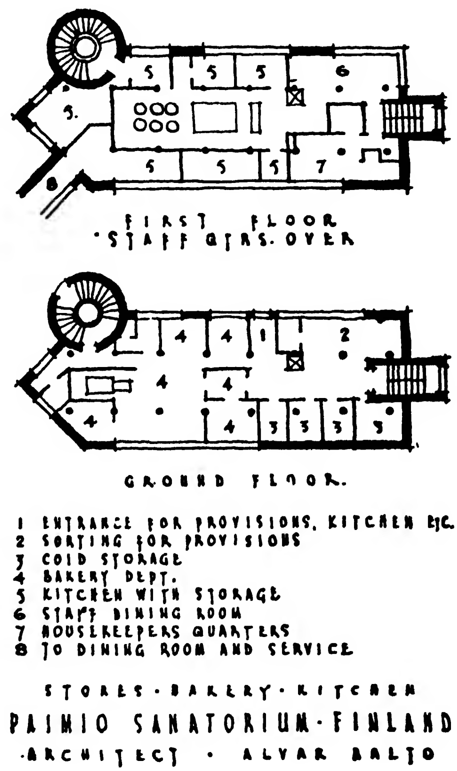


FIG. 16.

Larders. All the food larders or stores should be placed on the north side of the building, and may be further cooled by the provision of a refrigerating plant. An air-lock passage is desirable, running along the front of these stores, preventing air from the outside entering the separate units. When the stores are not supplied with refrigeration plant, they should be very well ventilated by providing air inlets at the floor level and extract ventilators at the ceiling, protected with wire gauze.

Separate larders or stores are required for meat, bacon, milk, dairy produce, butter, fish; and in addition there must always be one or two artificially cooled larders. With the rapid development of quick-frozen foods it is probable that the amount of refrigeration area will be much increased and that the trend will be towards more storage in the central store-room rather than the central kitchen. Keeping the kitchen storage requirements to a minimum—one to three days' supply for instance—usually permits

better functional planning of the kitchen proper and therefore more economical operation.

Each larder or store is differently equipped for a particular purpose: for example, the vegetable store will be provided with bins and the butcher's store with sink, chopping block, and scales. Each unit will be fitted with shelving of some description, such as Welsh slate, marble, or sparred racking supported from the wall. In meat stores and the like, hanging rails will be fitted, these to be of stainless steel at 9″ centres supported from the ceiling.

Refrigeration. In large central kitchens all food stores and larders are provided with refrigeration, as various temperatures are required in the different stores, and these are automatically maintained by thermostatic controls. The air coolers in the rooms are cased and the air is circulated by fans. An atmospheric condenser is placed on the roof over the stores to reduce water consumption to that which is required to make up losses by evaporation.

Mechanical refrigeration is normally provided:

a in central stores, for provisions and meat, at the capacity rate of 1 cu. ft. per bed;

b in central kitchens, for cooked meats and the perishables—60 to 100 cu. ft. per one thousand beds.

In addition to cooling these rooms, the refrigeration plant would be used for the manufacture of ice; accordingly storage space for this is necessary.

Ice. Ice-making plant should not be installed where ice can be purchased locally at a reasonable cost.

Large central refrigerating plant normally operates on the ammonia compression system. The machinery which controls the temperature is accommodated in a separate room, is fully automatic in operation, and only requires periodical inspection. All plant should be fitted with automatic stopping and starting equipment. The maximum and minimum limits generally worked to are 35 deg. to 38 deg. F.

The floors of stores used with refrigeration plant should be formed of two layers of 2″ cork slabs covered with 3″ granolithic or equivalent, and the roof (when external) with two layers of 2″ cork slabs, cement rendered. The walls of brick or concrete require rendering or tiling, and it is usual to tile the dairy produce larder, while a like finish is often used to similar stores with a quarry tile floor.

Hardware. An isolated store—i.e. a small detached building—must be provided for paraffin, colza oil, and floor cleaning materials, etc.

Drugs. These stores will be described in Chapter 17.

Linen. The linen store-rooms, which should be heated, comprise one for the ward

linen and another for staff linen. The linen is stored on shelving or arranged in cupboards round the room. Space for a large table, preferably in the centre, is needed for sorting and examining linen. The sewing room should have direct access to the linen room, and should be well lighted, warmed, and ventilated.

Patients' Clothing. In or near the central stores provision should be made for storing patients' personal clothing. This storage should be in addition to the small provision made for the same purpose in the wards. Accommodation on the basis of 25 per cent. of the number of patient beds should be provided (about 130 sq. ft. per four hundred beds).

FINISHINGS

Floors. The floors of larders for meat, fish, etc., should be of first-grade quarry tiles with tiled or glazed brick walls; whereas the other floors can be finished in granolithic or other composition flooring.

Walls. Cement glaze applied direct to brickwork is a suitable finish to the central stores, and, whilst the brick courses can be seen, an extremely pleasing appearance can be achieved which it would be impossible to obtain by any other method of treatment. The walls, treated thus, will present no difficulty whatever in keeping clean, as simple washing down is all that is necessary, whilst it is extremely difficult to deface the finish owing to the granite-hard nature of the surface.

Equipment. The interior of all rooms should be fitted appropriately with racks, cupboards, bins, counters, etc., suitably designed for the storage of the various articles, and on the lines of an up-to-date commercial stores building. The dimensions of shelving will vary according to the type of item to be stored.

9

The Central Kitchen

NAPOLEON SAID that an army marches on its stomach; it can be said with equal truth that the success of a hospital largely depends on the effectiveness of the central kitchen. At least, it is certain that no other single hospital service can contribute so much, day in and day out, to the welfare and satisfaction of both patients and staff as this service. As food and its service are of such vital importance, it is essential that the kitchen department be planned so that its beneficent function can be exercised to the fullest advantage. No patient should be gastronomically glad to leave the hospital; everything possible must be done to satiate his gastric passions and fulfil his alimentary longings. The average patient will accept his medical care without question, but is more likely to base his impressions of the hospital on the food service than anything else.

PLANNING

It is a moot point whether the hospital kitchen ought to be planned similarly to hotel kitchens. The extravagant demands of the latter are not usually met with in the hospital, though alternative diets must be available for the patient and staff to have some choice. Perhaps all the elaborate equipment of a hotel is not necessary, but at least the accommodation required for easy, smooth, and orderly working will be much on hotel lines.

Hospital kitchens differ from hotel kitchens principally in the fact that half the diners have to get food sent to them instead of coming to dining-rooms. In designing the kitchen it must be remembered, although contrary to general opinion, patients' meals represent not the major part but commonly not more than half of the total food provision. Food must reach the patient with the "hots" hot, the "colds" cold, and the entire tray presenting an appetising appearance. Preserving the proper temperature is largely a matter of the time lapse between service of the food from the bulk container to the tray and delivery of the tray to the patient.

Many methods of distribution and service, have been devised and each has its advocates, probably because of variations in the actual physical conditions in different hospitals—largely distance of travel either horizontal or vertical, from the kitchen to the patient. The methods of distribution and service may be classified generally as centralised and decentralised.

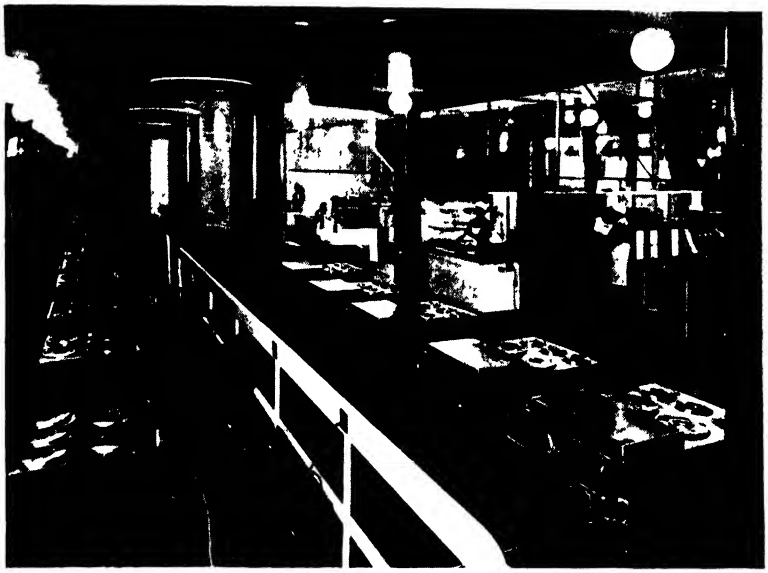


PLATE VII. Food Trolleys
General Hospital, Melbourne, Australia

PLATE VIII. Central Kitchen
Hospital Centre, Birmingham

[*To face page 70*

PLATE IX. Diet Kitchen
Hospital Centre, Birmingham

To face page 71]

Centralised in its extreme form involves complete service of the tray in the kitchen and its transport to the patient without intervening procedures. Since vertical transportation is more rapid than horizontal this method is particularly useful in multi-storeyed hospitals. This service in America is usually highly mechanised, with a travelling belt in the kitchen, each article of food being placed on the belt as it passes the server's station, the tray picked off the belt, and transported vertically on an automatically operating trayveyor, removed from the trayveyor at the designated ward kitchens and conveyed to the patient by the nurse or maid, either individually or on a tray trolley. The completely centralised and mechanised service has in some instances been credited with as much as 30 per cent. saving on raw food costs.

Decentralised service involves transportation of the food in bulk from the central kitchen to the ward kitchen and service to the patient either from the ward kitchen or at the bedside from a heated food trolley. Since the food retains its heat better while still in bulk and the bulk containers can be heated, the time lapse between service to the tray and service to the patient is shorter and less dependent upon the complete co-ordination of steps, and less subject to interruption by mechanical breakdown than is the completely centralised and mechanised service.

The use of any tray trolley type of service is subject to the fault that if it carries a sufficient number of trays for a standard nursing unit—25 to 30—the first tray on the trolley may have cooled down before the last tray is ready. Avoidance of this fault involves very close co-ordination and supervision of the serving and loading of the trays.

Irrespective of the method of service preferred, the selection must be made in advance of the design of the building so that all the necessary details can be incorporated.

Special trolleys having a cooled and a heated compartment each well insulated and permitting service at the bedside, prevent the food being spoilt on its way, but obviously a central position for the kitchen department is the best. It is appropriate to say that in a hospital of any size it is essential to have these insulated trolleys for the meals to be delivered expeditiously. By the adoption of a dispersal layout, as in a tuberculosis, mental, or isolation hospital, difficulties have been created in the distribution of food because it is essential for the sake of the patients, and also for the efficient operation of the central kitchen, that each meal-time should be at the same hour for all patients. The problem has been solved to some extent by the use of these trolleys (see Plate VII).

Much discussion has revolved round the position of the kitchen department in the general hospital plan, but it is generally agreed that it should be as far removed from the wards as is practical to avoid the noise and smell being disturbing or unpleasant to the patients. For this reason the unit has been planned on the top floors in some hospitals. At Southend—a three-storey hospital—the kitchen is on the first floor; at St. Helier, Carshalton—an eight-storey hospital—at the lower ground floor; and (the other extreme) at the Bata Health Centre, Czechoslovakia, the department is on the top floor, the twelfth, served by lifts from the ground floor (see Fig. 17). Despite the seeming disadvantages, those who have had experience with top-floor kitchens, generally favour this location. The problems of noise, heat, and odours are automatically solved.

Sanitation is much simpler because it becomes a "must". Receiving "up" and distributing "down" is simpler because receiving is in small numbers and in bulk, while the distribution of prepared foods runs into hundreds of deliveries per day, all in small amounts. Likewise the average patient is nearer the top floor than the ground floor because the lower floors are often occupied by non-patient areas. At the Southern Hospital in Stockholm the kitchen arrangements are interesting. From a central kitchen, situated on an upper floor, food is conveyed in a half-finished state to eleven branch kitchens, where cooking is completed and diet food prepared. From there it goes by lift to the various wards. The question remains an outstanding one. The majority of authorities in Great Britain consider, however, that the kitchen should be a one-storey building at ground level adjacent to the delivery yard for ease of access.

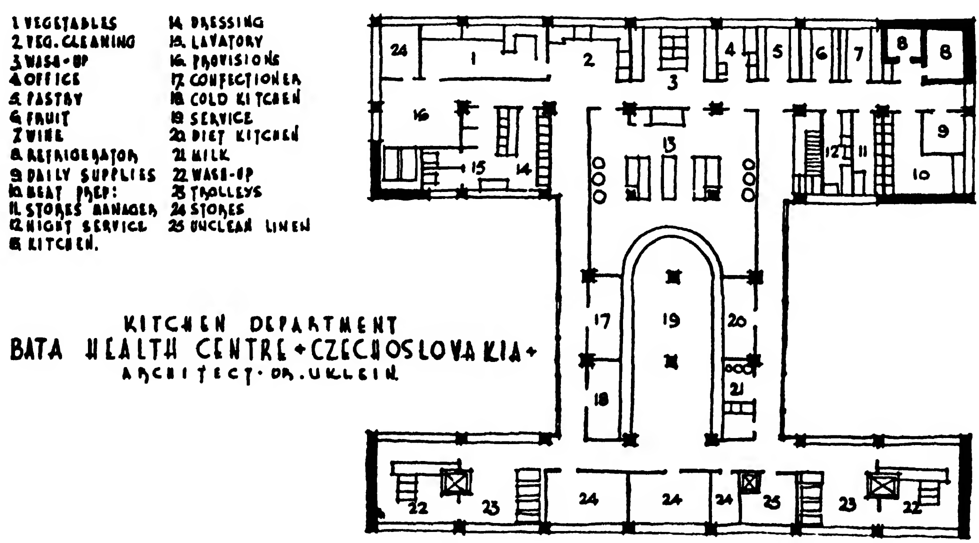


FIG. 17.

In this position, the objection that the smell of cooking penetrates into other parts of the hospital can be overcome by suitable planning. Even in compact sites where room cannot be spared for a single-storey building, one must remember that in built-up areas the purest air is at the top, and should therefore be reserved for patients who spend 24 hours of the day in their wards, rather than for the kitchen, although it will be in use for the greater part of every 24 hours when it is necessary to prepare hot meals for the night staff.

With a central situation the kitchen is often difficult to extend, and in the past, when hospitals have been extended by the erection of additional ward blocks, difficulties have sometimes arisen in providing for the necessary enlargement of the kitchen accommodation. The possibility of such an extension should therefore be borne in mind when the hospital is originally planned, and the kitchen should be so designed as to be readily capable of expansion. If the ultimate requirements can be foreseen, the

best plan will often be to build the kitchen at the outset to the ultimate size, and devote part of the space to stores until the whole accommodation is required for the kitchen. Building of additional stores is likely to be an easier matter than extending the kitchen.

When the kitchen is placed on the upper floors, if the rooms beneath are to be reasonably quiet, special care must be taken with all kitchen machinery. Any large item incorporating moving machinery—for instance, dish-washing or potato-peeling machines—should be placed on insulating supports.

The central kitchen should be separated from the main circulating corridor, and the separation should be in the form of a large service pantry containing trolley recesses and lifts to the various floors. The service pantry should be large enough to allow for easy and direct service of the electric trolleys, and all doors must be wide enough to allow these trolleys to pass easily. The most important service pantry should adjoin the kitchen and be served directly from the kitchen hot plate, while the smaller staff pantries which may be required should be served from the main one by suitable corridor connections. Cross circulation should be reduced to a minimum, although a certain amount can seldom be avoided. The pantry for ward service should be directly attached to the central kitchen and the scullery, and must have ample room for the preparation and parking of the food trolleys required.

The layout of the hospital kitchen and its equipment involves the consideration of the following items:

- *a* variations necessary owing to the different classes of patients;
- *b* whether there should be separate kitchens for patients and staff;
- *c* position;
- *d* type of equipment and services.

The necessity or otherwise for separate kitchens for patients and staff depends upon three factors:

- *a* the point at which the supervision and management of one large kitchen becomes unwieldy;
- *b* the position of the nurses' home and the dining arrangements for the staff affect the question in that, if such dining-rooms are in the staff quarters and some distance from the central kitchen, there arises the difficulty of transporting food so that it can be served hot and in an appetising form, and a separate staff kitchen may be desirable;
- *c* cost of building and equipment for one kitchen to serve both patients and staff will be materially lower than that of separate kitchens, and the cost of running and upkeep of one kitchen will also be lower than that of two separate kitchens.

If paying patients blocks are required to be totally separate, they must have a separate kitchen, otherwise the cooking is done in the central kitchen.

Some hospitals have their own bakery, and this must be built and equipped to produce bread under the most modern and scientific conditions.

Several store-rooms are required for cooks' storage of cooking utensils, china, glass, etc. Shelving and bins are needed in each to suit the various types of packages to be handled.

The kitchen should be considered as one of the most important departments for infection via food. Wash basins with elbow taps should be provided so that the staff can wash their hands under running water. All windows should be fly-proofed—but no doubt the fly menace will be solved by the use of D.D.T.

All this organisation and planning is futile if the kitchen department is under the control of an unskilled person, and therefore a person scientifically trained (experienced large-scale caterer) is required to supervise the department. Most modern hospitals now have a dietitian on the permanent staff in addition to the cook, for there are a great number of diseases, such as diabetes, pernicious anaemia, nephritis, constipation, and adiposity, where a scientific control of the diet given to patients is very necessary. A separate small kitchen off the main one is usually equipped for the dietitian.

ACCOMMODATION

Kitchen. A kitchen that is too large is likely to be as inconvenient as one that is too small, and therefore, before the kitchen is planned, the equipment which is to be installed must be determined. The room should be a broad rectangle in shape rather than a square, with an abundance of natural light and ventilation; top-light in addition to some side-light is desirable, as it leaves the maximum wall area clear for apparatus. The roof should be arranged without supports, as this leaves an unobstructed floor area for the arrangement of the various fittings comprising a thoroughly up-to-date and modern kitchen (see Plate VIII).

The kitchen should, if possible, project clear of the other buildings, and so have natural cross-ventilation, but to prevent the smell of cooking penetrating into the main building, the most satisfactory method of ventilation is by hoods and ducts connected to extract fans, and ventilating shaft carried up to the top of the building, preferably—if convenient—beside a chimney shaft, as then a natural suction is created in the shaft by virtue of the stack being warmed, thereby reducing the cost of expensive suction plant and power.

The Report states that information bearing on the size of the kitchen was collected, but as this department does not readily lend itself to the establishment of standards, they were unable to advise as to an area which would be generally suitable. The London County Council have investigated this matter, and state that the total area will vary from about 3½ sq. ft. per bed for a thousand-bed hospital to 4½ sq. ft. per bed for a three-hundred-bed hospital, assuming that it also supplies food for the staff, numbering up to 25 or 30 per cent. of the number of patients. This ratio of staff to patients is now somewhat increased. An important factor in determining the size is whether food trolleys will be loaded inside the kitchen or outside in a service pantry.

The total area ascertained from the previous paragraph is divided approximately into:

a 30 per cent. for kitchen section for roasting, frying, etc.;
b 5 per cent. for pastry preparation room;
c 5 per cent. for larder and refrigeration;
d 10 per cent. for servery;
e 5 per cent. for fish frying;
f 2½ per cent. for kitchen superintendent's store;
g 22½ per cent. for scullery where steaming and boiling operations are carried out;
h 7½ per cent. for vegetable preparation room;
i 7½ per cent. for cleaning pots and pans;
j 2½ per cent. for vegetable store;
k 2½ per cent. for fish store.

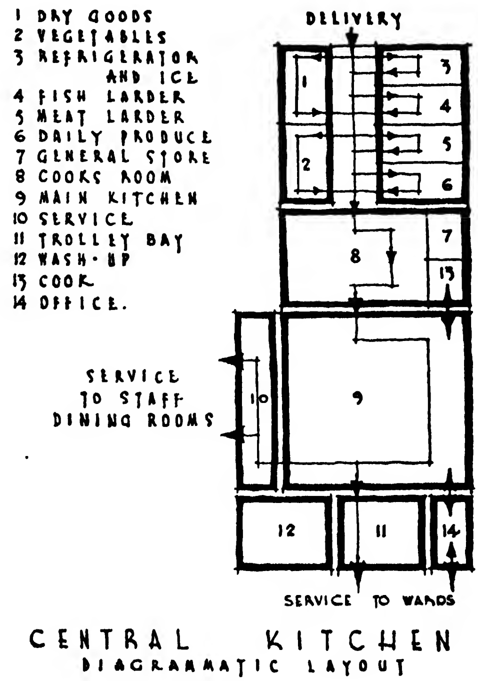


FIG. 18.

Much of the efficiency of the kitchen depends on the plan giving the correct progression from delivery of goods to ultimate service into the wards. Very careful thought is necessary to get the right arrangement of circulation: inward food to stores, from stores to preparation bays, and thence to the cooking bays, the servery, and the various destinations; and dirty dishes, pots, pans, and cutlery to their washing places without crossing the circulation. Fig. 18 indicates some of the circulations and deliveries required, and Fig. 20 a typical layout. The planning principles are:

a usually from left to right, i.e. draining-board on the left-hand side of the sink;
b avoid miscellaneous traffic through kitchen work areas;

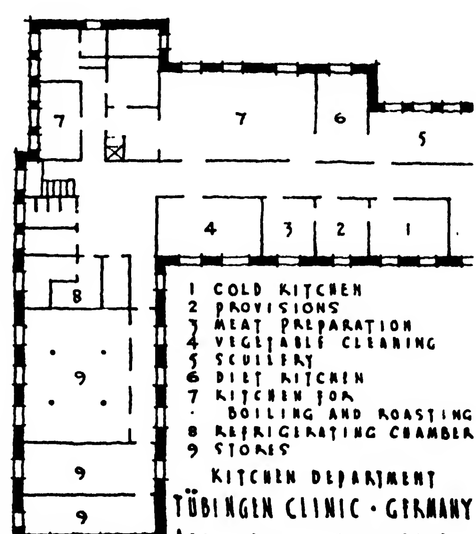


FIG. 19.

c non-working areas should be segregated from working areas;
d equipment should be organised into work centres;
e equip each work centre for storage of utensils, etc.;
f whenever possible, continuous work tops should be used to simplify cleaning.

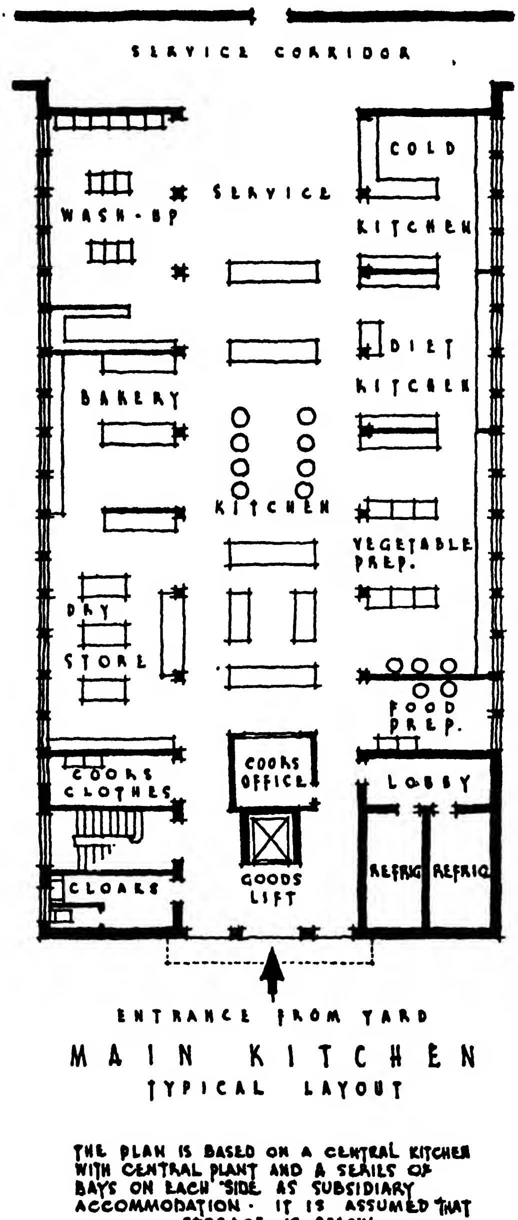


FIG. 20.

The usual layout plan is based on a central kitchen with central plant and a series of bays on each side as subsidiary accommodation. As an example the bays can be provided for:

a milk distribution
b cooks' stores
c crockery stores
d grocery stores
e bread stores
f vegetable preparation
g meat preparation
h fish preparation
i wash-up
j trolley wash
k pastry-room
l pass-over stores
m Jewish kosher meat
n Jewish kosher fish.

The equipment used should be of a modern type, and arranged in such a manner that the work is continuously progressive in the sense that raw food can be taken directly to the apparatus in which it is to be cooked and passed to the serving tables ready for transmission on special insulated food containers to various parts of the hospital.

The preparation bays or rooms require large sinks with washers discharging into open channels through a wire grating; and, for example, slate slabs and potato peeler are all that are really required in the vegetable preparation bay, in addition to bins sufficiently large to hold daily supplies of vegetables. For fish, the equipment needed is a sink with fire-clay slabs.

The scullery and wash-up should have direct entry from the kitchen, but openings should not extend to the ceiling, so as to help in extracting odours and steam directly from the scullery without risk of their penetration into the kitchen. Teak and stainless steel sinks are required with large draining-boards, and the latter should be hinged for cleaning.

Kosher kitchens for Jewish patients are sometimes required. When there is a large

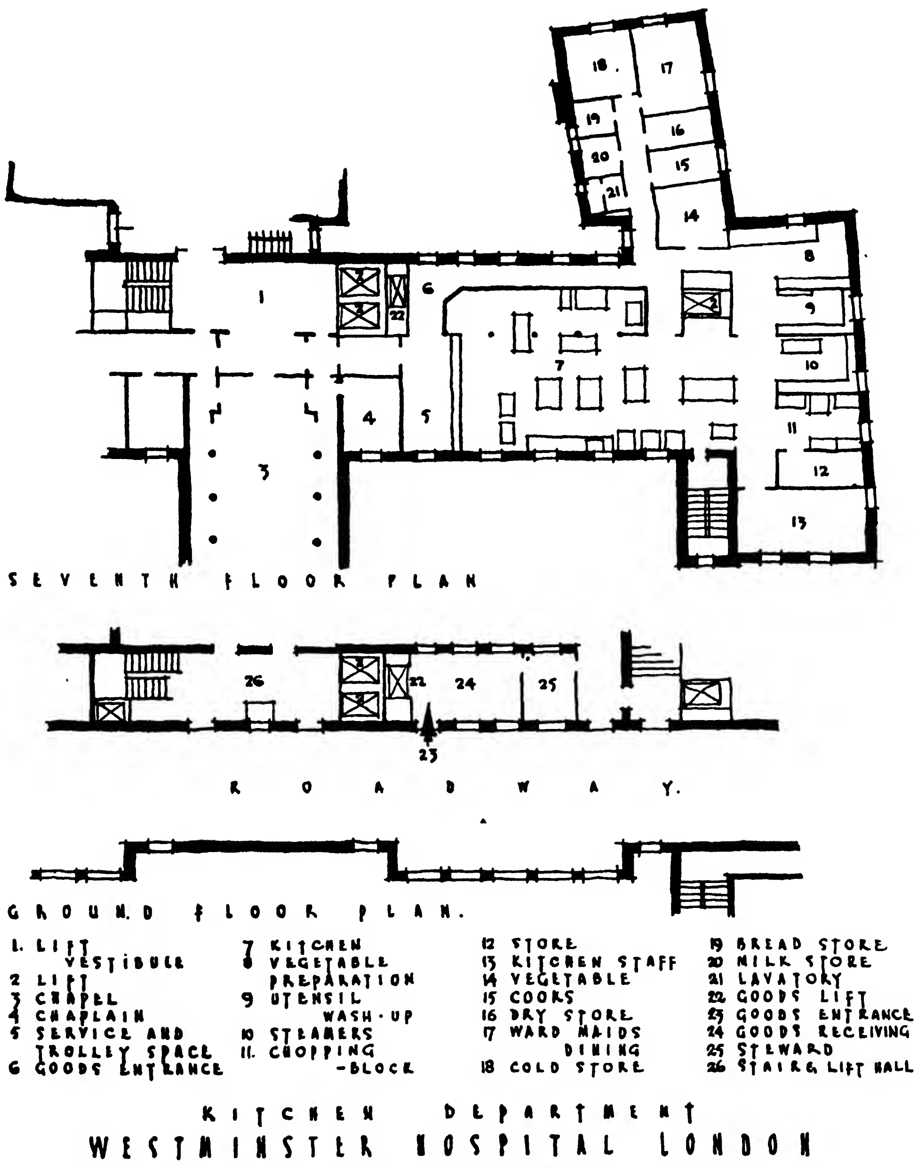


FIG. 21.

children's department, milk laboratories and bottle-sterilising rooms are necessary, but these are normally adjacent to the children's wards.

Increasing attention is being given to diet, and the cooks' duties are becoming onerous in consequence. Diet kitchens are now being introduced into all large hospitals to deal with specially prescribed diets.

See Figs. 19, 21 to 24 inclusive for alternative layouts for central kitchens.

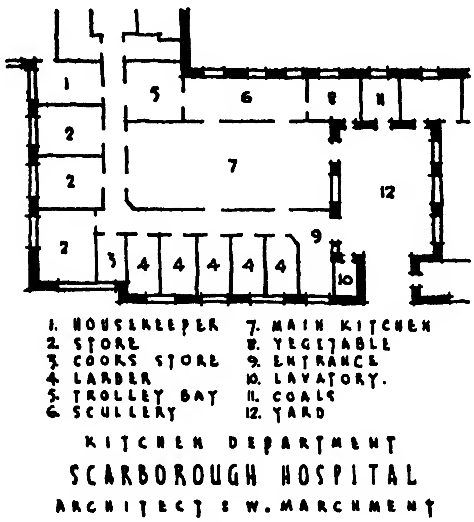


FIG. 22.

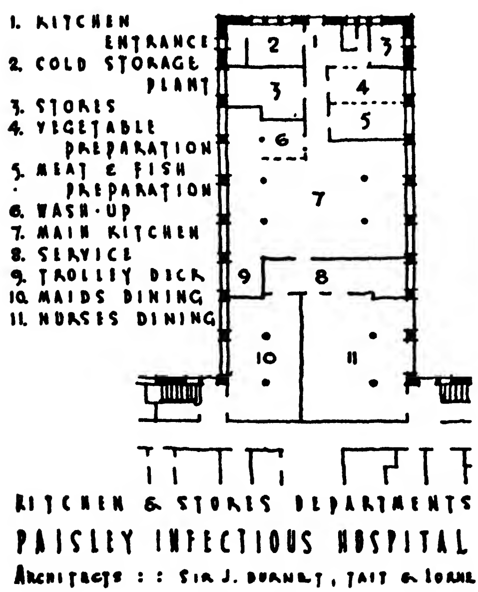


FIG. 23.

Bakery. The bakery should be arranged alongside the kitchen, so that there may be some common use of the ovens. It should be provided with a flour store on the upper floor, and on the outside a flour lift is required. The bread-cooling room may be a part of the bakehouse or may be situated near the central store from which the bread is issued. A properly equipped small sanitary annexe is essential.

The flour is cleaned and sifted and passed into the kneading machines which make the dough. The loaves are then baked in a battery of cantilever drawplate ovens which are very easy in operation.

Ventilation. If the buildings are designed with ample height with top windows that can be opened, side windows with hoppers and swing windows, gas ovens, etc., connected to fume ducts, and vent pipes from steam-jacketed pans run to external air, then mechanical ventilation will not be required. In passing, the humid atmosphere in kitchens reduces the life of galvanised iron ducting, and the use of asbestos cement for this purpose should be introduced.

The ventilation of the kitchen is not a question of the chemical purity of the air, as in crowded rooms, but of the physical reactions of individuals in overheated and very humid air. Consequently, ventilation should be designed to produce circulation of currents of air around the kitchen staff.

When mechanical ventilation is introduced, the plenum system, with air inlets about

1′ 6″ above the floor and properly spaced, will be more satisfactory than an extraction system. A scheme designed to provide six to eight changes of air per hour is recommended. If the kitchen is to be well ventilated, naturally the system requires all windows to be shut.

Equipment. Kitchen apparatus is constantly improving, and much of the very badly designed cooking plant is at last being superseded by easily cleaned, efficient units, worthy of the best hospital standards (see Plates VII and VIII).

In planning the kitchen all fixed equipment should be decided upon early, a large-scale drawing made showing each piece of equipment in place in its proper relation to all other pieces of equipment, door openings and traffic routes. It is only in the manner and with the service requirements of each piece of equipment that the mechanical engineer can determine the proper placement and capacities for the plumbing, piping, and electrical conduits and outlets.

The boiling pans, steamers, and ovens should be arranged round the walls, leaving the centre clear to facilitate the movement of the staff. This arrangement enables the water, gas, and steam services to the plant to be run in a less obvious manner. The cooking appliances, steam pipes, etc., where arranged against the walls, should be kept 6″ clear of walls, and hot plates, cupboards, dressers, etc., 4″ clear of the floors, while pipes should be 2″ clear of walls, measuring from the non-conducting material. When the kitchen is on the lowest floor, the service pipes can be distributed below the floor, and there are therefore only short lengths of pipe visible in the kitchen. Access to them is, however, necessary, and is usually provided from one of the subways. Every piece of equipment should be carried on cantilever brackets in order to obviate obstructive legs. All unnecessary projections should be avoided, as they are the major cause of crockery breakages.

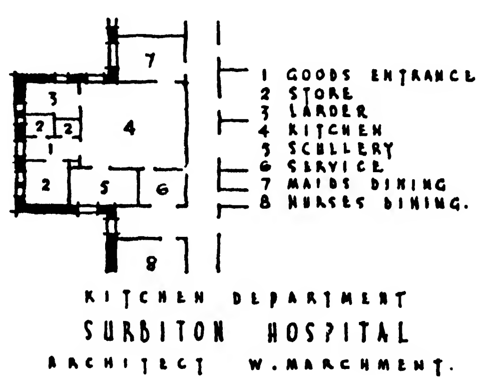


FIG. 24.

The fuels normally available for use are coal, gas, and electricity. Gas is most commonly used, but improvements in coal ranges, particularly the so-called Swedish range burning anthracite coal, have led to its adoption in some hospitals with a great deal of satisfaction. Electricity is, however, gaining in favour. Since combustion does not take place in the kitchen there is less radiated heat, less consumption of the oxygen in the air, and less odour. Electric ranges make use of the fireless cooker principle, and are therefore particularly adaptable for baking and roasting. In these processes there is less loss of moisture, the finished product sometimes weighing as much as 10 per cent. more than when roasted in the conventional coal or gas-heated oven. Electricity is not

generally so much favoured for top cooking, but the use of specially designed flat-bottom cooking utensils has obviated some of the objections to electrical top cooking. Such comparative tests as have been made indicate that in overall efficiency and economy electricity at one penny per kilowatt hour is about equivalent to gas at one shilling and eight pence per thousand cubic feet. Much depends on the price of gas or electricity in the locality in deciding which will be used. Kitchen demand for steam is small and except for holidays extends over approximately the same periods of time as for the laundry. Steam for cooking is a convenience and an economy, but is not as necessary as are the other uses of steam.

The salaries of this department ordinarily represent from a quarter to one-third or even more of its operational total cost. It is clear that the provision of labour-saving machinery and the general arrangements of the kitchen itself are major factors in controlling the salary cost. Much of this machine preparation also improves the quality of the food. Thus hand peeling of potatoes is not only laborious but wastes a large amount of the potato richest in vitamins. Machine beating of batter-mixes increases the bulk by as much as 10 per cent. Machine slicing of meat ensures uniform thickness of slices and this uniformity itself permits more accurate and therefore more economical sizing of portions. Machine washing of dishes reduces breakages by as much as 50 per cent., all but eliminates the labour of hand drying, and is the best means of sterilising the dishes.

The general equipment and plant provided in most central kitchens consists of the following apparatus:

a for roasting baking and frying: gas heated, electrically heated, or coke-fired ovens; gas boiling tables and gas-heated fish fryer with hot closet under;

b for boiling and steaming: steam-jacketed pans for vegetables, soups, milk, boiled meats, etc., of either fixed or tilting types; steamers of one, two, three or more compartments for fish, boiled puddings, potatoes, etc.;

c for warming purposes: steam, gas, or electrically heated hot closets;

d labour saving appliances: machines for food mixing, meat slicing, potato paring, bread cutting, and dish washing;

e other appliances: ham boiler containers, refrigerators, steam-heated kettles for tea, and tea-making apparatus.

With the introduction of labour-saving equipment and with careful planning, considerable economy of space can be obtained. The equipment should have wearing surfaces of stainless steel, and the tables, draining boards, etc., provided with stainless steel tops. Oven doors should be of self-closing type, and above the boiling pans will be required a runway to facilitate moving of the heavy baskets when lifted from the pans.

Steamers and ovens should be grouped under exhaust hoods. These hoods can consist of glass screens and are desirable to prevent the spread of smells and gases. Method of extraction of these fumes should be mechanical. To provide an opening in the outer wall, in the hope that the steam will escape through it naturally, is quite useless.

Another small but essential item is the gutter under the bottom edge of each hood to receive the condensation water (and save it from dripping on the cooks), each to be provided with a small outlet pipe carried down to discharge into floor channel.

FINISHINGS

The ease with which the walls and floors can be cleaned is of vital importance, but, in this connection, there is another factor which is sometimes ignored, viz. that surfaces differ in the ease with which they can be soiled. For example, a porous surface will hold oil and dirt much more easily than a highly glazed one, and as a result the cleaning of the porous surface is much more difficult.

Wear and tear includes not only the actual frictional wear and tear due to abrasion in the ordinary use of floor and walls, but also the damage which may arise from abrasion in cleaning. With floors and walls it should be remembered that the surface means everything, and once the surface is damaged, as a rule the material can be said to be ruined, except in the case of certain floorings of a non-decorative character.

Floors. In considering floor-coverings, it will be obvious that a perfect kitchen flooring should be continuous, resilient, impervious to water, non-slip, resistant to soil, and easily cleaned. A variety of materials are available for use, all of which possess certain of the properties outlined above; but few combine all the qualities mentioned.

Floors built up on a foundation of concrete and finished with a layer of jointless material have the advantage of being very durable and can be made practically impervious to water. They also keep their appearance, since they will withstand the most vigorous cleaning methods, but the actual cleaning is often laborious owing to the porosity of the surface. Furthermore, care is required in laying such floors or absorption of moisture may occur and produce lifting or cracking. Certain types of such flooring may become very slippery when wet, but in general they may be considered safe for working. It is sometimes considered that solid floors of this type are not sufficiently resilient to be restful, though this is by no means certain, particularly in the case of jointless asphalt type of flooring. This material possesses most of the properties desirable in a floor and has been found most nearly to approach the perfect flooring. This material is laid in the hot condition, and when cool forms a waterproof restful surface of pleasing appearance, especially if one of the coloured varieties of asphalt is used.

Of the other types of floor materials quarry tiles find wide application. These if properly laid on a waterproof foundation, form a floor which is durable, easily cleaned, and impervious to water, but are liable to be slippery, especially when wet. The Report recommends the use of first-grade quarry tiles.

The floor to the kitchen is an important matter. It should generally fall to channels formed at definite points to ensure that the water used for washing the surface will flow freely to the drain. The waste water from the boiling pans, steamers, etc., should be directed into gutters from which a cast-iron pipe with the necessary cleaning pits should

be carried outside to the drain. The importance of grease-traps and the need for steps to be taken to avoid blocking of the drains must be emphasised.

Walls. One of the chief points which must be decided before wall and ceiling coverings can be chosen is whether they should be porous or non-porous, and this is governed largely by the question of condensation. It is well known that under certain conditions of temperature and humidity condensation of water takes place on the walls and may ultimately cause the walls to become unsightly. Condensation is particularly important in the kitchen, although tests have shown that the humidity does not rise above a point at which it would affect the worker. The atmosphere will generally be temperate in other parts of the hospital, and, in addition, one or more of the walls in the kitchen will be an outside wall, so that the temperature of a large area of wall surface will be lower than in other parts of the hospital.

From tests carried out in connection with the atmospheric conditions in kitchens it may be said that condensation will occur in practically all kitchens. In the case of a non-porous surface condensation is visible, this fact probably accounting for the objections to this type of surface. It is a common misapprehension that, as there is no moisture visible on a porous surface, no condensation is taking place. This is entirely erroneous, since the porous surface absorbs the moisture condensed on it.

Frequently the moist atmosphere of kitchens is charged with fine particles of grease from cooking apparatus and some of these particles are deposited and absorbed by the wall surface; ultimately this causes unsightly marks on walls. A smooth, non-porous surface is most satisfactory for kitchens, and it is emphasised in this connection that the presence of visible moisture on walls will generally not be harmful to the surface or occupants of kitchens, and should not be taken as a sign of excessively damp air conditions.

Numerous materials are available which will give satisfactory service in the kitchen; these include wall tiles, decorated asbestos sheets, opaque glass, and numerous synthetic materials which may be obtained in sheets either plain or with tiled patterns. Mention should also be made of the metal-faced plywoods. The material, of course, would require to be covered with an untarnishable metal, and in particular plywood covered with anodised aluminium (which is untarnishable and can be obtained in a variety of colours) might be used to provide an unusual decorative scheme.

Generally speaking, these materials are more expensive than good quality tiles. After examination of numerous materials of this kind, it is evident that the use of glazed earthenware tiles will give an effect equal to most of the more modern decorative materials. In general, tiles with an egg-shell gloss are more suitable and attractive than those with a high gloss, since the latter may be responsible in certain circumstances for an objectionable glare which may affect the kitchen staff.

The Report is of the opinion that the walls should be of tile or glazed brick up to a height of 6′; with the upper part of painted plaster or smooth bricks and paint finish.

Ceilings. Cement glaze applied direct to the constructional surface gives a pleasing and hygienic finish, and it is simple to keep clean.

10

The Staff Dining-rooms

THE DINING-ROOMS, with service rooms and sculleries, for medical staff officers, matron, nursing, domestic, and male staffs should be within a short distance of the central kitchen so that service is easy and ensures freshness of food. It is the general opinion that the provision of one kitchen to serve both patients and staff is undoubtedly the most economical arrangement, both in the initial cost of construction and also in the subsequent cost of operation, since it leads to a saving of staff and enables the whole organisation to be placed under one skilled supervisor. Special consideration should be given to staff meals, but they need not lose in attractiveness through being cooked in the central kitchen if suitable administrative measures, such as the appointment of an assistant cook for the staff, are taken.

In recent years the cafeteria system has been adopted in some hospitals. This system saves staff, enables meals to be taken more quickly, and a greater variety of dishes can be offered. It is particularly suitable for staff who pay for their meals, e.g. most non-residents, but it can be used for all staff, including medical officers. A disadvantage is that nurses, who are on their feet all day, like to be waited on at their meals, but despite this many nurses prefer the cafeteria system. With a cafeteria there should be a coffee and smoking annexe with plenty of easy chairs.

PLANNING

From the psychological point of view it is desirable that nurses should be free from the hospital atmosphere at meal-times, and there is a greater possibility of the dining-rooms being in a pleasanter environment if they are situated in the nurses' home. Another factor to be considered is that whereas the patients have their meals at certain fixed times, the nursing staff meals are required at varying times during the day. The night nurses require a hot meal at night, so that there is an almost continuous demand on any kitchen supplying meals for nursing staff. Against this must be placed the inconvenience of travelling a distance, frequently in the open, for each meal, and this objection is particularly marked in the case of such meals as mid-morning tea, afternoon tea, and, above all, the night nurses' meals. In some hospitals the night nurses' meals are cooked and eaten in the ward kitchens, but this practice has grave disadvantages, and in progressive hospitals a properly cooked meal is provided in the dining-room. Further, if the dining-rooms are in the nurses' home, food must be transported

to them from a distance, unless a separate kitchen is provided. In some instances, e.g. in a very large hospital, it may be justifiable to provide dining-rooms and a separate kitchen and stores in the nurses' home.

The dining-rooms should be given a pleasant outlook, and although aspect is not of primary importance, sun at sometime during the day is an advantage. Separate dining-rooms may be provided for:

a house physicians
b sisters
c staff nurses and student nurses
d female domestic staff
e officers who are normally non-resident, such as clerical staff, male nursing staff or attendants, and male domestic staff.

It is usual to have folding doors between the sisters' and the nurses' dining-rooms so that the two can be thrown into one for entertainment purposes. The numbers of separate dining-rooms for non-resident staff should be kept as low as possible.

The largest dining-room should, if possible, be connected to the service pantry on its long side, and two service doors should be provided between the room and service pantry to separate "in" and "out" traffic.

Tables should not be too long and should be at right angles to the wall in which the service doors are placed. Each person requires about 2′ 6″ run of table space, and gangways should be 3′ wide between backs of chair and 4′ wide round the walls. Small tables for four or six persons are preferable and The Report recommends that they should be regarded as the standard provision. Although they involve a slightly larger space per person, small tables are more sociable than long tables, and they facilitate the clearing of the dining-rooms for cleaning or for entertainments.

ACCOMMODATION

Doctors. For the house surgeons and physicians, a room calculated on a basis of at least 15 sq. ft. per person should be allowed. It should be placed in such a situation that it may be served rapidly from the central kitchen, but at the same time it should be quiet and be near their common rooms.

Nurses. The size of the dining-rooms should be based on an allowance of 10 to 14 sq. ft. per person on the maximum number expected for any one meal; the number is usually a few more than half the total number of nurses. It seldom happens that more than half the nursing staff can be present at any one time, for allowances must be made for those on duty, the night staff, and those who are away for off-duty time; only on rare occasions it may be necessary for 75 per cent. of the staff to be accommodated.

If all small tables are provided a floor area of 13 to 14 sq. ft. per person is required, and if long tables were provided a minimum of 10 sq. ft. per person. The senior staff

(sisters and administrative staff) should have dining-room accommodation separate from that of staff nurses and student nurses and be large enough to accommodate the total number of the grades.

Maids. For the female domestic staff (both hospital and nurses' home) the room may be based on an allowance of 10 sq. ft. per person, except that a larger proportion will need serving at the same time, and the area should be based on about 75 per cent. of the staff.

Lavatories. It is essential that appropriate lavatory and cloakroom accommodation should be provided for the staff in close proximity to the dining-rooms and that lavatory accommodation should be provided for male visitors.

FINISHINGS

These rooms must be attractively decorated and as far as possible attractively furnished. It is said that food does one most good if it is not only well-cooked, hot and pleasantly served, but eaten in surroundings which are also really pleasant, in other words the architect and the cook have a very important combination and function in the efficient feeding of the hospital staff.

Floors should be of hardwood or linoleum laid direct on cement screeding and the walls of ordinary plaster, painted or distempered, with a hard plaster dado.

11

The Residential Accommodation

GREAT ATTENTION—and deservedly so—is being paid to the accommodation of the hospital staff of all classes. These very necessary servants of the public do work which is arduous and often unpleasant, and a greater consideration of their comfort is long overdue. It is being realised that the maintenance of a good and efficient staff depends largely on the accommodation provided for them and the facilities at hand for enjoying their leisure.

Hospital authorities, however, cannot be completely absolved from the suspicion that this increased consideration is not the sole reason for their great activity in this matter. The desire to attract in even greater numbers a suitable type of girl to the nursing profession merits every encouragement, and everything possible should be done to secure this desirable type. Undoubtedly, comfortable homes in hospitals will contribute to this end.

The Ministry of Health memorandum "Staffing the Hospitals" (1945) states the standard of accommodation which should be aimed at in all hospitals as follows:

a every nurse should have her own well-furnished room with adequate ventilation, heating, and lighting (conveniently placed, for reading), a bedside switch, a comfortable arm chair, and if possible a fitted basin, with hot and cold water laid on; where fitted basins cannot be provided in the nurses' rooms, there should be a readily accessible and adequately equipped toilet-room curtained off into cubicles; a space of at least 100 sq. ft. should be allowed for each nurse's room;

b there should be constant hot water for bathing and there should be at least one bath and one lavatory for every six nurses;

c there should be shampoo rooms and facilities for the washing and ironing of small articles;

d kitchenettes should be provided for the use of the nurses;

e quarters for night staff should be so arranged as to minimise noise during sleeping hours;

f a library and reading-room, a recreation room equipped with wireless and facilities for indoor games, a guest room in which visitors of both sexes can be received, and cloakrooms for guests should be provided; suitable provision should also be made for outdoor recreation and in particular a tennis court, should, wherever possible, be provided and maintained;

g all rooms should be well lighted and ventilated, cheerfully decorated, and attractively furnished on modern lines;

h a public telephone should be provided in the nurses' home;

i adequate toilet, cloakroom, and rest-room accommodation and facilities for meals or refreshments during hours of duty should be provided at the hospital for those who live out.

Unless the student nurse's home is reasonably near the hospital she should reside within its curtilage during her student days. She should be housed in a hostel, presided over by a warden, who should be responsible to the chief administrator for the order of the hostel and well-being of the nurses.

There is a good deal to be said for making the residence in hospitals of all State-registered nurses and sisters optional. The Lancet Commission on Nursing once suggested that the trained members of the staff should be allowed to "live out," as the hospital staff "living in" became cramped in their outlook and became "institutional." It would, of course, be more expensive for the hospital to give allowances in lieu of board and living accommodation, but if this principle is adopted the accommodation of the future nurses' home could be reduced by about 30 per cent., with a corresponding saving on capital outlay. In America the former practice of providing homes within the hospital grounds is quite rapidly giving way to raising salaries to such a level as to provide for living costs and encouraging as many as possible of the personnel to live outside. There it is less the result of economic considerations than of recognition of the fact that normal, unregimented, home living contributes much to the morale of the employee.

PERSONNEL

The requirements must necessarily vary in different hospitals according to their situation and other circumstances. For example, both the nurses' working hours and the class of work done in the hospital have a bearing on the number of nurses required. Again, though there must be some resident domestic staff, it is usual for some to be non-resident, the proportion varying considerably. Male attendants, engineers, porters, gardeners, etc., are commonly non-resident, and accordingly it is unnecessary to consider the provision of quarters for them.

Medical Staff. The practice in municipal hospitals is to provide a separate house standing in its own grounds, with a tennis court, for the chief administrator and small houses or self-contained flats for one or more married medical officers. The Report emphasises the importance of this, as it was found that without the provision of such separate accommodation outside the administration department it is difficult to retain the right type of men in the hospital medical service.

The following accommodation is recommended in The Report as being suitable for these purposes, the total areas given being those within external walls :

a	Chief administrator or superintendent of a large hospital.	Three living-rooms; four or six bedrooms; two bathrooms and cloakroom; large kitchen or small kitchen and maids' sitting-room. Total—3,000 sq. ft.
b	Chief administrator or superintendent of a medium size hospital—say 400 beds.	Slightly smaller than above, but five bedrooms. Total—2,750 sq. ft.
c	Deputy administrator or superintendent of a large hospital.	Three living-rooms; four bedrooms; bathroom; kitchen. Total—2,250 sq. ft.
d	Married medical officer's small house or self-contained flat.	Two living-rooms; three bedrooms; bathroom; kitchenette. Total (if a house)—1,650 sq. ft.

Other resident medical officers may be housed in the administration department. This has the advantage that their quarters are at the administrative centre of the hospital, in convenient relation to the wards and casualty rooms, and also near the central kitchen, so facilitating the service of their meals. It is better if the married full-time officers can live within a short distance of the hospital in which their patients are warded, as comparatively few ought of necessity to live in. The doctor who, living near the hospital, spends most of his leisure in his home, will usually be of greater value than the resident who spends all his available free time visiting his wife or friends some distance away.

The resident staff living in are usually males only—house physicians—it is therefore desirable to separate their quarters from the other residential quarters. During the war there has been a growing proportion of women medical officers. In the planning stage it must be decided whether women medical officers are to be engaged or not and the accommodation provided accordingly. Each medical officer should have a sitting-room and bedroom with a total superficial area of about 240 sq. ft., and provided with a lavatory basin. The bathrooms should be in the proportion of one to three officers, and, together with the W.Cs., store and box-room, should be so arranged that they adjoin the bedrooms and can be reached preferably without entering the main corridor circulations. An extra bedroom should be available for a locum tenens taking the place of a sick medical officer.

There should be a common dining-room with a serving pantry. In determining the size of the dining-room, the needs of the visiting medical staff should be taken into account. A common sitting-room, large enough to accommodate a billiards table, is desirable, for these persons deserve the maximum of comfort during the few spare hours they have together off duty.

Steward. Although not a medical man, his sphere is an important one, and therefore, providing he lives in, similar accommodation as for the married resident medical officers is provided for this officer.

The Matron. The accommodation of this responsible officer deserves more consideration than it often receives. Her quarters ought to be so placed that she is not living cheek-by-jowl with the other staff, and therefore a separate entrance is required.

It is desirable, when possible, to give the matron a house in the grounds with a separate access to the street, the reason being that one must envisage the possibility of matrons of the future as married or widowed with children. Alternatively the accommodation may be provided either in the administration department or in a section of the nurses' home. The administration department is usually preferable, but in either case her quarters should be self-contained, and should comprise rooms of the following areas: kitchenette, 100 sq. ft.; dining-room, 150 sq. ft.; two bedrooms, 150 and 120 sq. ft.; together with bathroom, W.C., and storage accommodation.

The Assistant Matron. She may be accommodated either in the administration department or in the nurses' home. She should have a bedroom and a sitting-room. As she is usually accommodated in the home, she has been considered in relation with it.

Warden. The appointment to take charge of the nurses' home of a qualified or experienced woman officer—not necessarily a nurse—who is directly responsible to the competent hospital authority, has done much to help in securing the necessary sense of freedom from hospital discipline in off-duty hours. This officer is also responsible for the general well-being of the nurses under her care and aims at securing a happy and homely atmosphere in the nurses' home.

The control and supervision of domestic staff should, whenever the numbers justify it, be assigned to a similar officer. This officer works in consultation with, but not necessarily under the control of, the matron, and should have access to the appropriate hospital committee.

Resident Domestic Staff. These are the senior kitchen staff, doctors' and matron's maids, and the domestic and ward maids. In a highly populated area many of them will live out, whereas in an isolated area they will nearly all live in.

A limited number must always live in to maintain essential services, and accommodation for them may be made either in the administration department or in a section of the nurses' home. In a very large hospital it would probably be found more convenient to house the domestic staff in a separate maids' home. When the domestic staff are incorporated in the nurses' home, separate entrances are often required, so that the maids do not associate with the nursing staff.

Senior members of the domestic staff (i.e. the cook, laundry supervisor) should have bed-sitting rooms or bedrooms and sitting-rooms. The rest of the domestic staff should be provided with a common sitting-room, bedroom, bathroom, and ancillary rooms on the same scale as student nurses. The accommodation has been reviewed in detail in Chapter 6—domestic quarters.

When the sleeping accommodation is on the upper floor of the administration department, the situation of the accommodation should be well removed, with separate access from that provided for the medical staff in this building, to obviate disturbance by noise.

It is impossible to over-emphasise the value and importance of the many kinds of domestic and other non-nursing work which keep the wheels of a hospital turning. Domestic workers are, with doctors, nurses, and all other hospital staff, part of a team whose co-operative work has one aim in view—the care of the patient; and an efficient hospital service cannot exist without a full complement of workers in all branches.

Resident Engineer. His sphere, like that of the steward, is an important one. The desirability of providing a house or a flat for him should be considered.

PLANNING

The training school and accommodation for sisters, nurses, and student nurses, and also the domestic staff, unless the latter are accommodated in the administration department or in a separate maids' home, are thus left to be provided for in the nurses' home. The Report states it was found that the concensus of opinion was against housing the nursing staff in the administration department, as it was considered that the nurses when off duty should be at some distance from the wards and out of the hospital atmosphere. This may not always be possible in the case of a very small hospital, but in the case of an acute general hospital for about four hundred beds a separate nurses' home is recommended.

All modern hospitals of any size have separate staff homes. It is only right that the nursing staff should be able to get right away from the hospital atmosphere when their arduous day's work is done. The homes should, nevertheless, be in the hospital grounds, and connected to the main blocks by means of a subway or a covered way. If possible, they should be sited with a quiet garden and with such recreational facilities as tennis courts.

A matter of primary importance is the need for the separation of the various grades of nursing staff. The separation of the trained from the untrained staff is considered by some essential for the maintenance of discipline. Further, to ensure privacy and ease of running, the building should be planned in distinct zones:

a sisters' accommodation and ancillaries
b nurses' accommodation and ancillaries
c maids' accommodation and ancillaries
d special provision for the night staff who require to sleep during the day,

all of which should at some point lead directly to a common staircase or vestibule.

There are those who think that in the past too much has been made of segregation

of the different grades of nurses. These "social distinctions" have tended to increase the difficulties of recruiting student nurses.

The provision of the accommodation in a series of smaller homes has been under review. While there appears to be no obvious advantage from the standpoint of building costs in the adoption of such an arrangement, there are cases—such as may arise in certain special hospitals (infectious diseases, etc.) where the number of patients is liable to considerable fluctuation—where a series of smaller homes that admit of units being closed when not required might present definite advantages in minimising running charges and may be well entitled to consideration.

When the hospital is sited away from the centre of a town, a bicycle shed and garages will be required. These can be incorporated with those for the rest of the hospital staff.

The plans (Figs. 25 to 32 inclusive) indicate nurses homes of various sizes and layout.

COMMON ROOMS

Vestibule. This should be large enough to serve as a waiting-room for callers.

All occupants and visitors to the home should pass through the vestibule controlled by the enquiry office, and they will then be seen by either the warden or other responsible person, when leaving or entering the building. The only communication between nurses' and maids' part of the building—except at entrance vestibule—should be through fire-escape doors at each floor level.

Great care must be exercised in the design of the entrance vestibule, so that it gives a good first impression and affords an air of welcome (see Plate X). Opening out of the vestibule, should be the warden or home sister's office, with enquiry hatch, and a public telephone kiosk which is essential.

Office. The warden or home sister should have an office of about 100 sq. ft. in area, equipped with a keyboard, medicine cupboard, and facilities for minor dressings, etc., so that it may also serve as a surgery. Provision for records and a stationery store are also required.

Attendant's Room. In the larger homes this is desirable, otherwise parcels are handed in to the warden's office. The attendant is engaged in answering telephone calls, taking and delivering messages and various domestic duties.

Cloak Rooms. These are desirable on the ground floor for resident and for non-resident domestic staff engaged in the nurses' home.

Visitors' Room. In addition to the usual sitting-rooms for the different grades, a few small rooms where any member of the staff can receive her personal visitors without encroaching on the common rooms are an added amenity. There should be a W.C.

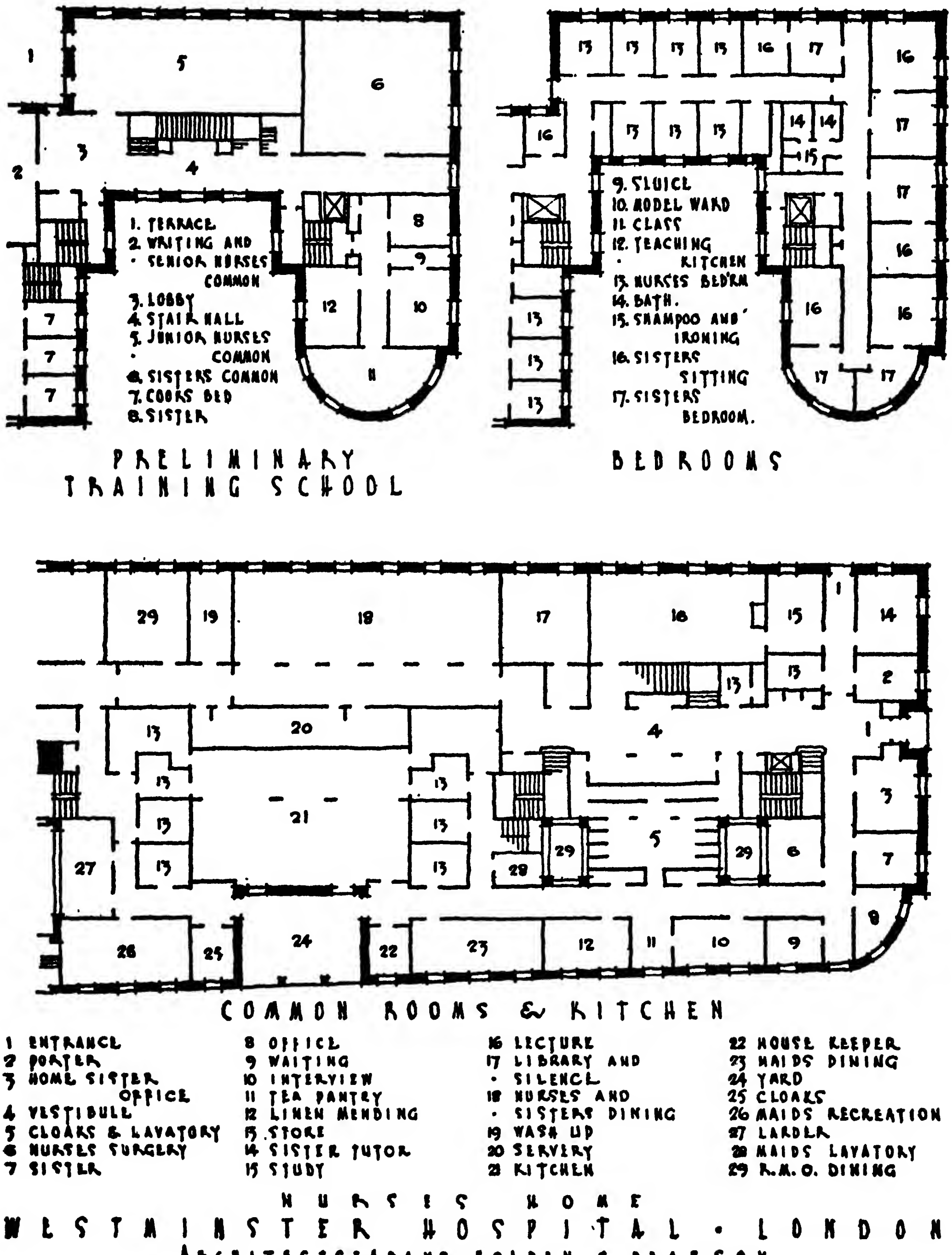

1. TERRACE
2. WRITING AND SENIOR NURSES COMMON
3. LOBBY
4. STAIR HALL
5. JUNIOR NURSES COMMON
6. SISTERS COMMON
7. COOKS BED
8. SISTER
PRELIMINARY TRAINING SCHOOL
9. SLUICE
10. MODEL WARD
11. CLASS
12. TEACHING KITCHEN
13. NURSES BED'RM
14. BATH.
15. SHAMPOO AND IRONING
16. SISTERS SITTING
17. SISTERS BEDROOM.
BEDROOMS
COMMON ROOMS & KITCHEN
1 ENTRANCE
2 PORTER
3 HOME SISTER OFFICE
4 VESTIBULE
5 CLOAKS & LAVATORY
6 NURSES SURGERY
7 SISTER
8 OFFICE
9 WAITING
10 INTERVIEW
11 TEA PANTRY
12 LINEN MENDING
13 STORE
14 SISTER TUTOR
15 STUDY
16 LECTURE
17 LIBRARY AND SILENCE
18 NURSES AND SISTERS DINING
19 WASH UP
20 SERVERY
21 KITCHEN
22 HOUSE KEEPER
23 MAIDS DINING
24 YARD
25 CLOAKS
26 MAIDS RECREATION
27 LARDER
28 MAIDS LAVATORY
29 R.M.O. DINING
NURSES HOME
WESTMINSTER HOSPITAL · LONDON
ARCHITECTS: ADAMS, HOLDEN, & PEARSON

FIG. 25.

PLATE X. Vestibule
General Hospital, Macclesfield

PLATE XI. Recreation Room
Royal Masonic Hospital, London

[*To face page 92*

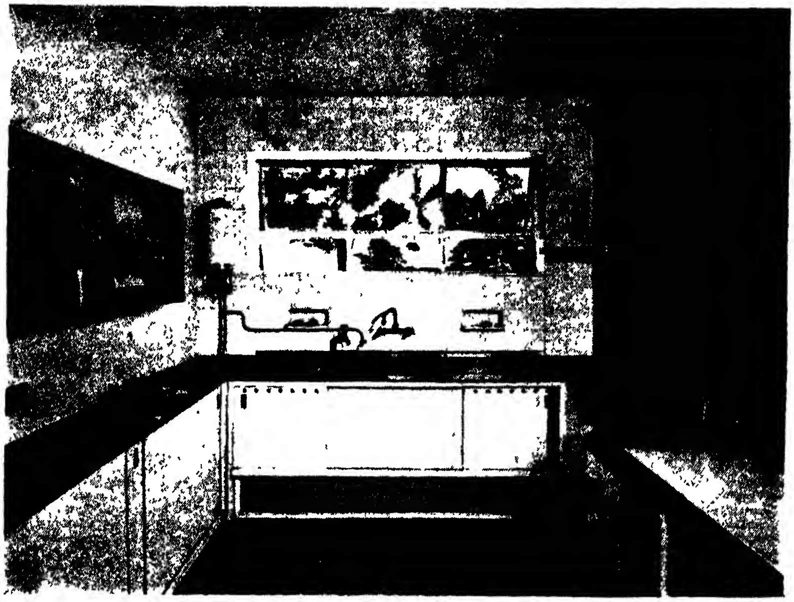


PLATE XII. Tea Kitchen
General Hospital, Macclesfield

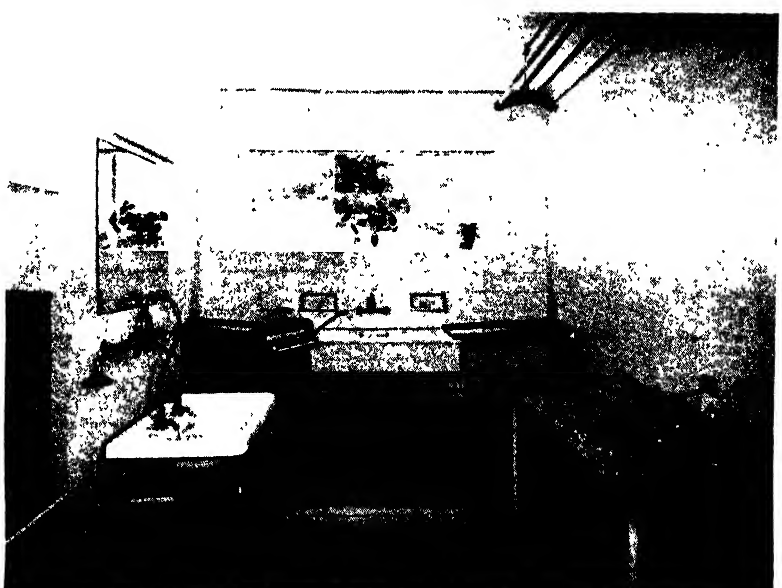


PLATE XIII. Laundry
General Hospital, Macclesfield

To face page 93]

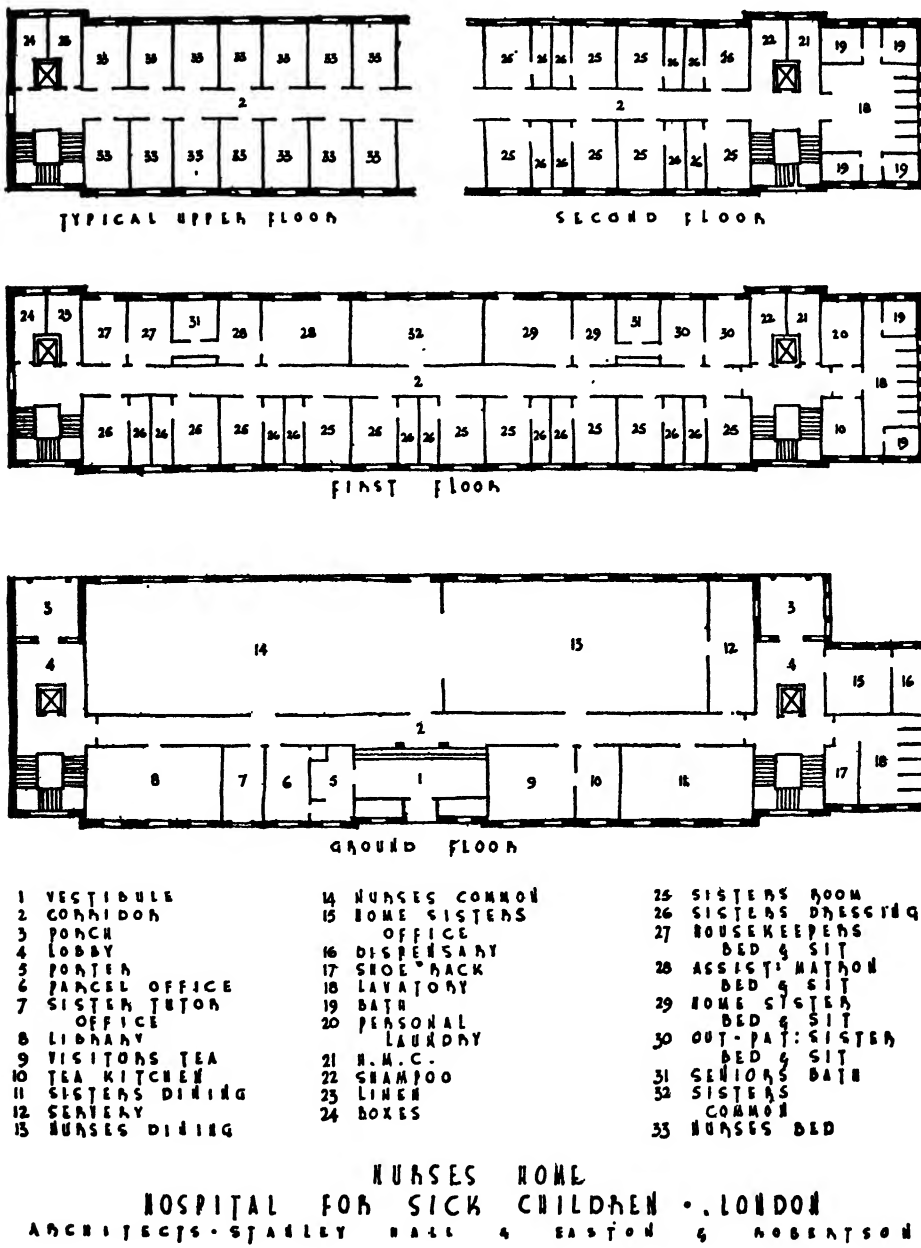

TYPICAL UPPER FLOOR
SECOND FLOOR
FIRST FLOOR
GROUND FLOOR
1 VESTIBULE
2 CORRIDOR
3 PORCH
4 LOBBY
5 PORTER
6 PARCEL OFFICE
7 SISTER TUTOR OFFICE
8 LIBRARY
9 VISITORS TEA
10 TEA KITCHEN
11 SISTERS DINING
12 SERVERY
13 NURSES DINING
14 NURSES COMMON
15 HOME SISTERS OFFICE
16 DISPENSARY
17 SHOE RACK
18 LAVATORY
19 BATH
20 PERSONAL LAUNDRY
21 N.M.C.
22 SHAMPOO
23 LINEN
24 BOXES
25 SISTERS ROOM
26 SISTERS DRESSING
27 HOUSEKEEPERS BED & SIT
28 ASSIST: MATRON BED & SIT
29 HOME SISTER BED & SIT
30 OUT-PAT: SISTER BED & SIT
31 SENIORS BATH
32 SISTERS COMMON
33 NURSES BED
NURSES HOME
HOSPITAL FOR SICK CHILDREN · LONDON
ARCHITECTS · STANLEY HALL & EASTON & ROBERTSON

FIG. 26.

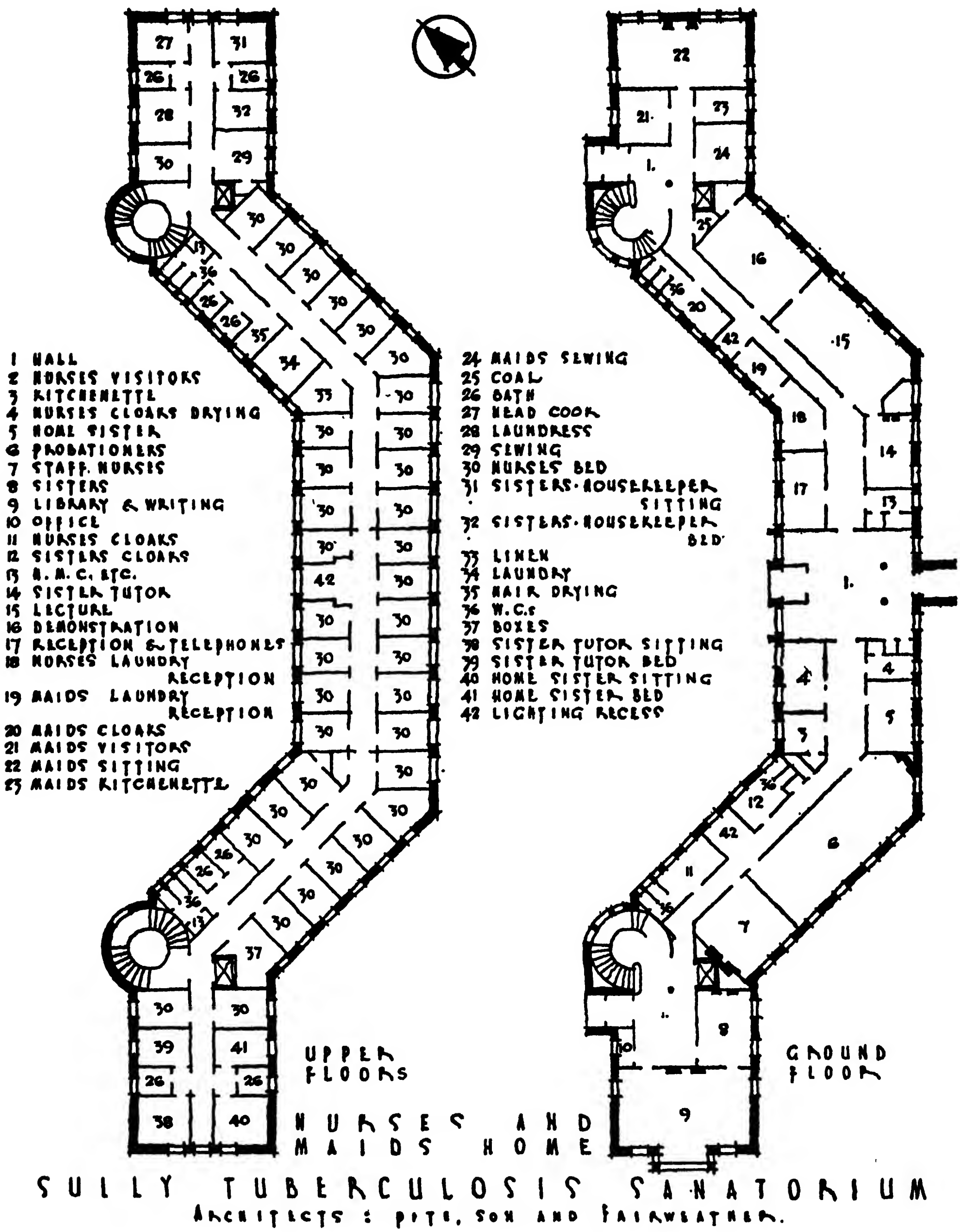

1 HALL
2 NURSES VISITORS
3 KITCHENETTE
4 NURSES CLOAKS DRYING
5 HOME SISTER
6 PROBATIONERS
7 STAFF. NURSES
8 SISTERS
9 LIBRARY & WRITING
10 OFFICE
11 NURSES CLOAKS
12 SISTERS CLOAKS
13 H. M. C. ETC.
14 SISTER TUTOR
15 LECTURE
16 DEMONSTRATION
17 RECEPTION & TELEPHONES
18 NURSES LAUNDRY RECEPTION
19 MAIDS LAUNDRY RECEPTION
20 MAIDS CLOAKS
21 MAIDS VISITORS
22 MAIDS SITTING
23 MAIDS KITCHENETTE
24 MAIDS SEWING
25 COAL
26 BATH
27 HEAD COOK
28 LAUNDRESS
29 SEWING
30 NURSES BED
31 SISTERS. HOUSEKEEPER SITTING
32 SISTERS. HOUSEKEEPER BED
33 LINEN
34 LAUNDRY
35 HAIR DRYING
36 W.C.s
37 BOXES
38 SISTER TUTOR SITTING
39 SISTER TUTOR BED
40 HOME SISTER SITTING
41 HOME SISTER BED
42 LIGHTING RECESS
UPPER FLOORS
GROUND FLOOR
NURSES AND MAIDS HOME
SULLY TUBERCULOSIS SANATORIUM
ARCHITECTS : PITE, SON AND FAIRWEATHER.

FIG. 27.

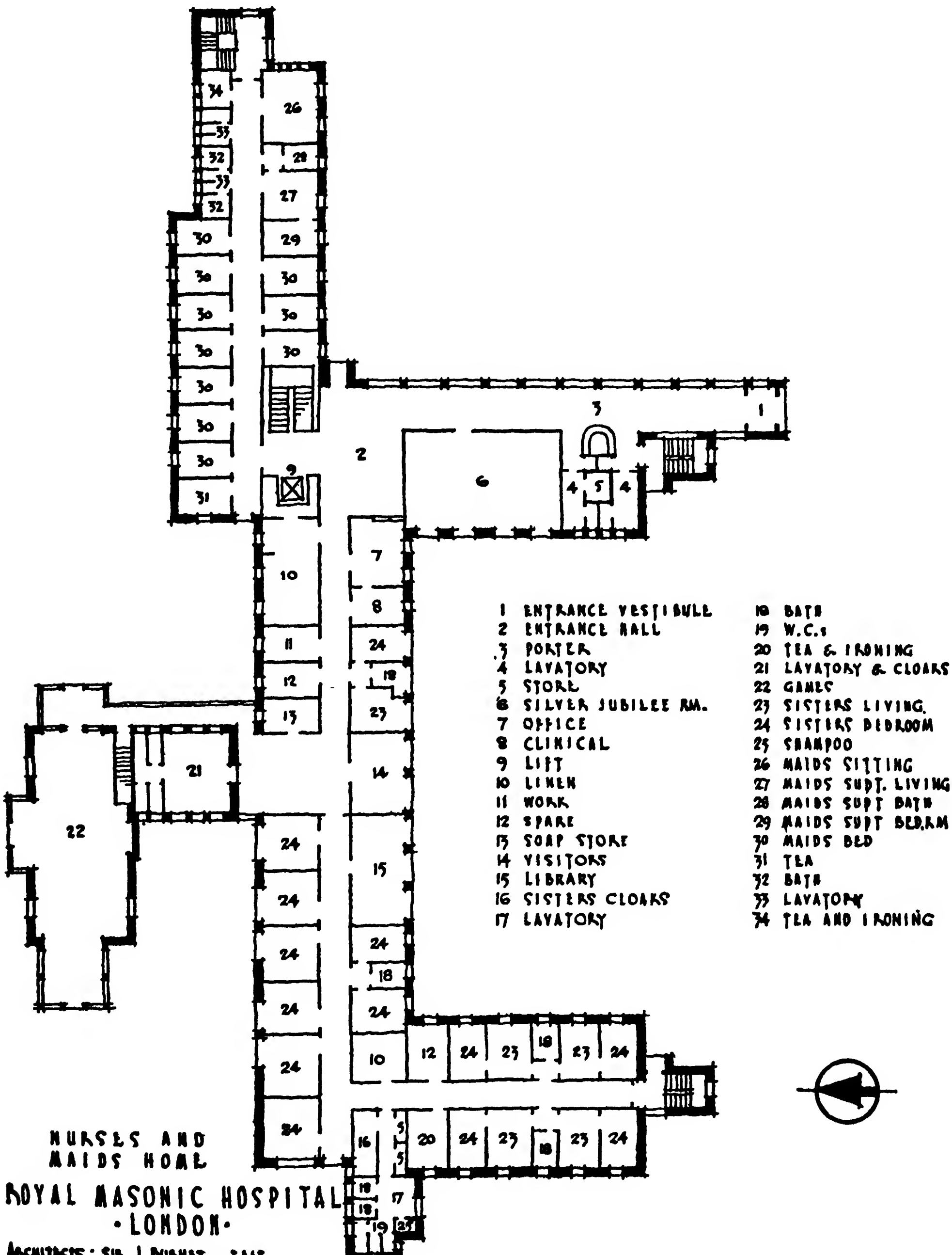

1 ENTRANCE VESTIBULE
2 ENTRANCE HALL
3 PORTER
4 LAVATORY
5 STORE
6 SILVER JUBILEE RM.
7 OFFICE
8 CLINICAL
9 LIFT
10 LINEN
11 WORK
12 SPARE
13 SOAP STORE
14 VISITORS
15 LIBRARY
16 SISTERS CLOAKS
17 LAVATORY
18 BATH
19 W.C.s
20 TEA & IRONING
21 LAVATORY & CLOAKS
22 GAMES
23 SISTERS LIVING
24 SISTERS BEDROOM
25 SHAMPOO
26 MAIDS SITTING
27 MAIDS SUPT. LIVING
28 MAIDS SUPT BATH
29 MAIDS SUPT BED.RM
30 MAIDS BED
31 TEA
32 BATH
33 LAVATORY
34 TEA AND IRONING
NURSES AND MAIDS HOME
ROYAL MASONIC HOSPITAL
· LONDON ·
ARCHITECTS: SIR. J. BURNET, TAIT. & LORNE.

FIG. 28.

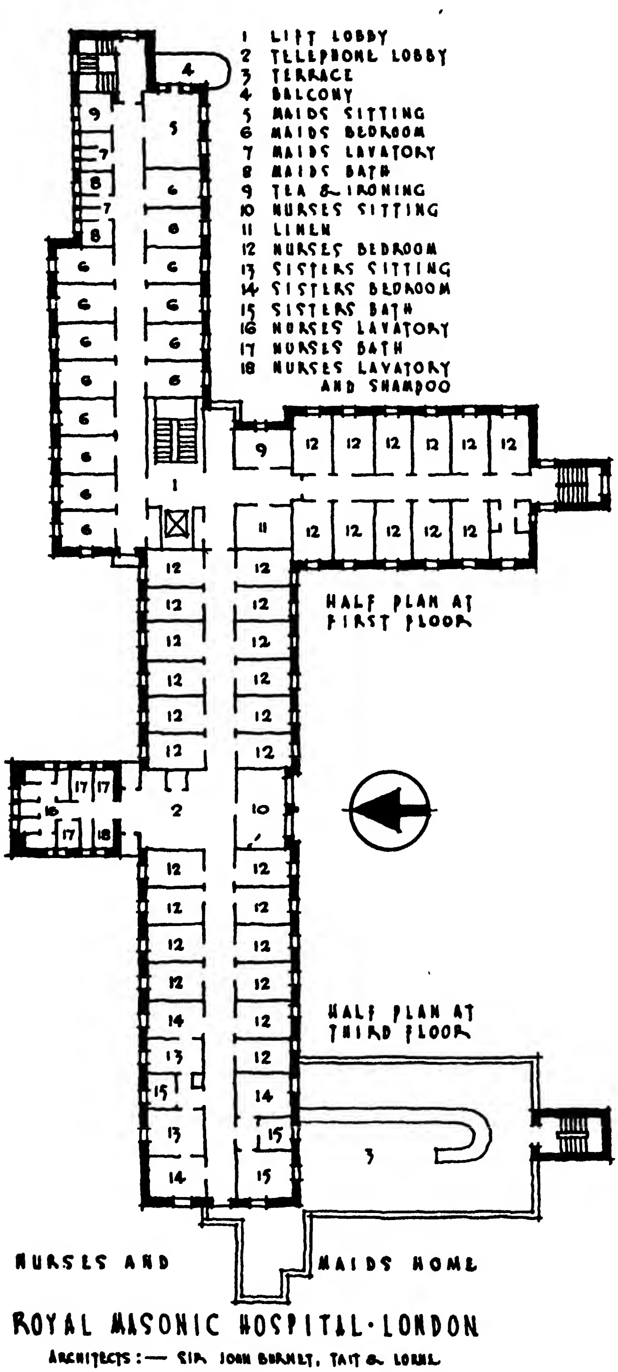


FIG. 29.

and cloakroom accessible for male visitors. Every endeavour should be made to plan one of the tea pantries adjacent, so that nurses can entertain their visitors to tea.

In small homes the visitors' room should be planned en suite with the other common rooms and separated by a folding partition in order that the whole suite of rooms may be used as a large recreation room.

Shop. In large homes a self-supporting shop, controlled by the nursing staff, for the sale of miscellaneous articles is a convenience to the staff.

Dining-room. Some committees consider that there should be a separate kitchen and dining-room in the nurses' home; this is purely a matter of opinion. The Report came to the conclusion that the dining-rooms for the various nursing grades should be situated in the administration department and be served by the central kitchen. The question of dining-rooms and kitchen has been dealt with fully in Chapters 9 and 10.

When the nurses' home is entirely self-contained, kitchen and stores are provided and supplied from the central stores of the hospital. It is suggested that even then some portion of the cooking might be done in the central hospital kitchen.

Wherever the dining-rooms are situated, the meals should be served

well away from the wards, food should be well cooked, served hot and attractively presented with sufficient variety. Hot drinks, and suppers or light snacks should be available for nurses returning from off-duty periods late at night. Nurses on night duty should not have to cook for themselves, and special attention should be given to the provision of their meals, which should be taken in a room set aside for the purpose.

Tea Kitchen. Although the nurses may have their main meals in the administration department, a completely equipped small kitchen is required for keeping food warm. storing milk, butter, etc., and for preparing tea or simple meals.

It should be placed near the sitting-rooms in an unimportant and cool position. Only a

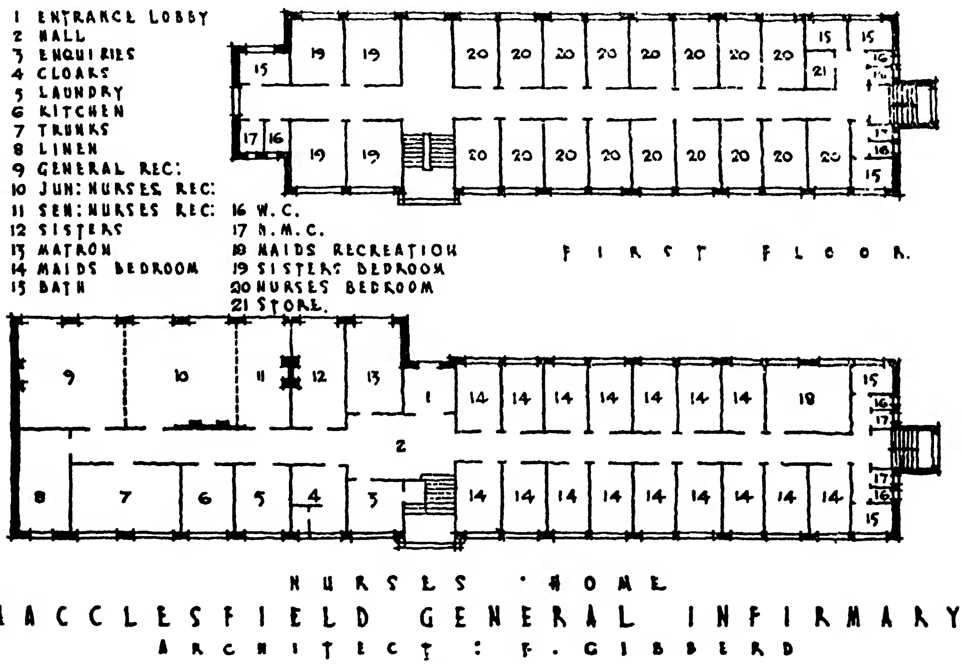


FIG. 30.

small larder within the kitchen is needed, as stores are provided from the central kitchen. A room having an area of 80 sq. ft. including the larder is generally adequate, with a gas or electric cooker, sink and draining-boards, and the underside of the sink enclosed by cupboards with sliding doors. Other features required are work-table, battery of storage cupboards, hanging china cupboard with sliding glass doors (see Plate XII).

Sitting or Common Rooms. Different hospitals have different views as to the nurses' common room. At Leeds Hospital each "year" have their own common room, with one large recreation room for parties. Other hospitals have one large common room for all nurses and a small common room for sisters.

It is usual to find common rooms are used to a limited extent only. Bedrooms

7

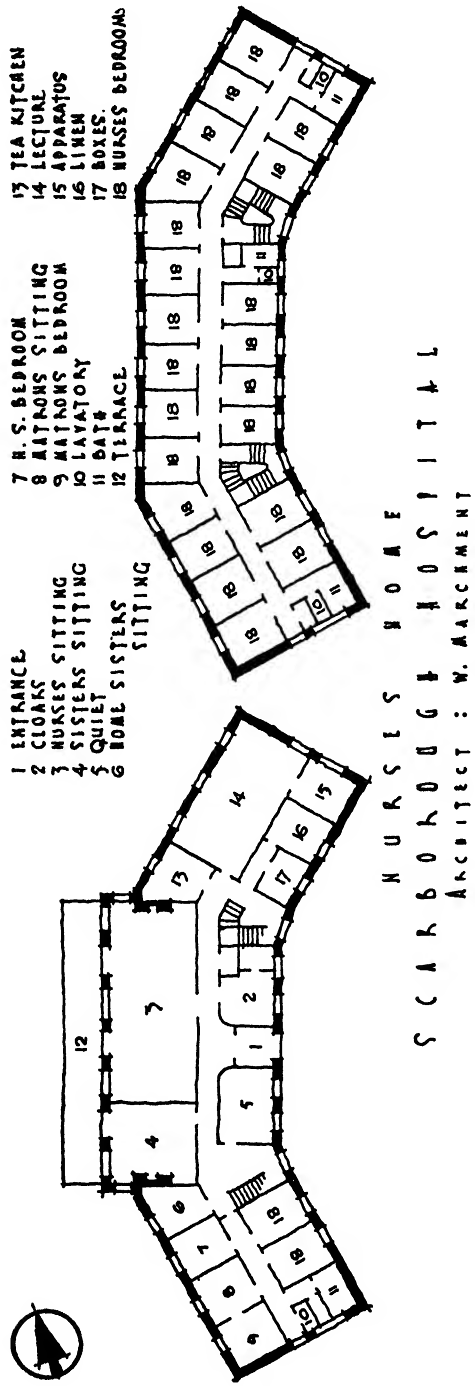


Fig. 31.

suitably planned and furnished enable the common sitting-room accommodation to be reduced, as many nurses prefer to sit in their own bedrooms and in particular the older nurses who appreciate an opportunity for privacy which they can obtain only in their bedrooms.

Separate sitting-rooms are usually provided for the sisters, the staff nurses, and the student nurses. The future policy may be to provide one sitting-room only. On the basis of separate sitting-rooms for each grade at least 20 sq. ft. per head should be allowed in the sisters' room, estimated on the total number of staff of that grade. Twenty sq. ft. should be allowed for each staff nurse and 12 sq. ft. for each student nurse, the number of occupants being reckoned as two-thirds of the total staff of each of these grades. Where the number of nurses in any grade is very small, The Report states some increase in the amount per head of sitting-room will be necessary.

When the sitting-rooms of staff nurses and student nurses are adjacent to each other, they should be separated by folding doors, which can be thrown back to make one large room for entertaining. This renders the provision of a separate recreation room unnecessary. When all common rooms are inter-communicating and only divided by folding doors, a stage is sometimes provided at one end, with a proscenium curtain. If the stage is not movable, the underneath can be made useful for storage, especially if the floor is sunk sufficiently low to give headroom. If chairs are of the resting or folding type, little space will be required for them. In a large home there should be a small property store adjacent to the stage.

The common rooms should all look on to a wide paved terrace and, if possible, laid-out gardens. The rooms want large windows stretching from floor to ceiling, with glazed doors, so that the rooms can be thrown open to the terrace in the summer, thus forming one large leisure unit.

Although the rooms will be centrally heated, coal fires should be provided to form cheerful sitting areas in winter. Electric clocks, radio for broadcasts, and electric points for reading lamps are required. At the Royal Masonic Hospital a system of special call signals is provided to each room.

The sisters' sitting-room is sometimes planned at the sisters' bedroom floor level. The maids' sitting-room is planned with their bedrooms.

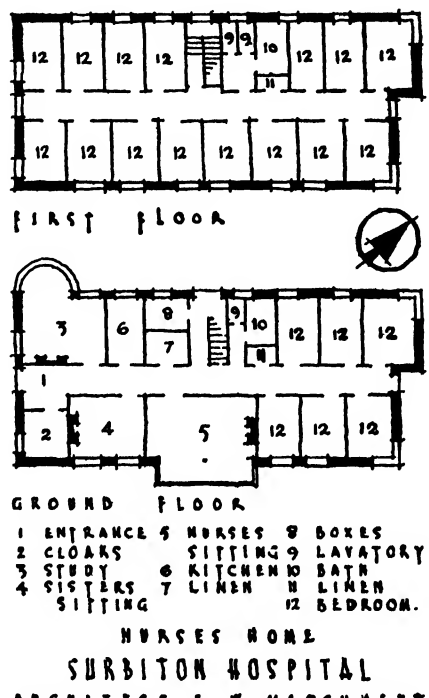


FIG. 32.

Reading-room. A small reading-room or quiet room for writing or study may be provided, and this can also serve as a library. It should be in such a position that it is unaffected by noise from the general sitting-rooms. If a training school is part of the home, then the reading-room will form part of its accommodation.

Some authorities provide a library in lieu of reading, writing, and common study rooms. This will then be a combined fiction and reference library, with a number of tables and chairs provided, the library being situated in convenient proximity to the common rooms.

Games Room. In some large homes these are desirable, with provision for table tennis and such games. Some authorities think a games room is almost more important in a small home than in a large one, as it is much more difficult to arrange community life in the former.

Corridors. A fault of many nurses' home plans, and one which must be avoided, is the provision of long, dull, internal corridors with insufficient lighting and poor ventilation. Generally speaking, internal corridors cannot be avoided, and the difficulty of lighting is overcome to a certain extent by large windows at either end and by glazed fan-lights above each bedroom door. In very long corridors, lighting recesses—similar to those for the ward unit—must be provided.

The main corridors on the ground floor should be at least 7′ wide, decreased on bedroom floors to 5′. The London County Council have reduced the latter to 4′ 6″.

There should be a "calling bell" on each floor operated from the warden's office, and also an electric clock.

The main staircase is to give access to corridors, each of which should be designed to serve its own particular suite, so that student nurses do not pass sisters' or nurses' bedrooms, and vice versa. Secondary staircases should be arranged to provide each corridor on the upper floors with alternative means of escape to a fire exit. These secondary staircases are also desirable for use by the maids for access to nurses' bedrooms for cleaning, etc.

Lift. The conveyance of linen baskets, trucks, etc., up and down the staircase of a home of several floors entails considerable labour and is likely to result in damage to the walls and staircase, and therefore a goods lift should be installed in homes exceeding two storeys. In homes exceeding three storeys a combined passenger and goods lift should be provided, as the initial cost of this lift would soon be paid for by the additional service, repair and renovation of walls and fabric, and increased porterage if no lift were provided. The lift to be of the automatic push button type without the self-levelling control.

BEDROOMS AND ANCILLARIES

Bedrooms. All bedrooms should be planned with either east or west aspect and the rooms should be placed back to back, so that two rooms share common pipe services contained in a vertical duct (see Figs. 33 and 34).

Bedrooms should be planned to give the following:

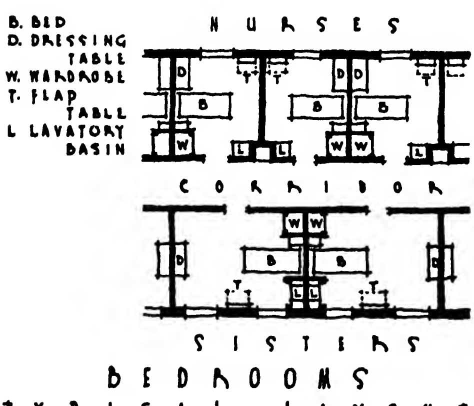


FIG. 33.

a bed with space at the side for a table;
b fitted lavatory basin and mirror next to the window where there is a maximum of light;
c space for dressing-table by the window;
d storage cupboards or wardrobes facing the widest effective part of the room: some long drawers for nurses' starched clothes and small drawers for collars are desirable;
e heated towel rail;
f small book-case;
g comfortable armchair and two other chairs.

Too much care cannot be given to the design of these rooms, as sisters and nurses should not be subjected to ugly and inartistic rooms. This room will be their only retreat for privacy, and in the early days of their nursing career many hours will be spent in it at study. The adoption of the principle of providing a suitable and comfortably furnished bedroom for each member of the nursing staff in recognition of the need

for privacy and comfort is a means of economy by the definite reduction of common room accommodation.

Some schemes do not differentiate between the requirements for sisters, nurses, and for student nurses, but The Report recommends additional superficial area for the sisters. A question of some difficulty is the extent to which use should be made of the ground floor for sleeping purposes. It is known there are objections to this on the part of some nurses, but it will not usually be found possible to plan a home economically without making some use of the ground floor for sleeping purposes.

It is generally accepted that each nurse ought to have a bedroom for her sole use, but in this connection the tendency—now manifest in official circles—to impose minimum standards should be guarded against. The bedroom should not be so small that the occupant is liable to suffer from claustrophobia, nor so large that the authorities are tempted to make it serve for two persons.

Invariably every nurse will have a separate bedroom. As to size, 12′ by 10′ is ideal, 10′ by 10′ is quite usual, and an area of 100 sq. ft. including the space occupied by built-in furniture is recommended in The Report. The size 11′ by 7′ 8″, exclusive of built-in furniture, was being aimed at by the London County Council, but not adopted. This would only be possible by careful consideration of the type of fittings and furniture selected, the furniture to be specially designed to suit the room and effectively to serve its purpose.

The nurses' and maids' bedrooms (if provided in the one home) are identical, the sisters' are 50 per cent. wider, but of the same length, so that the wardrobes, lavatory basin plumbing, and heating units are identical throughout (see Fig. 33).

The home sister will live in this department, and, like the other administrative sisters, should have a suite of sitting-room and bedroom with a superficial area of 240 sq. ft., of which the sitting-room will contain 140 sq. ft. These sisters' rooms will be designed in suites of two, sharing a bathroom and W.C. If the assistant matron lives in the home, she is the senior officer, and may be given a flat consisting of sitting-room and two bedrooms, with bathroom and W.C.; the total superficial area required is about 400 sq. ft.

Sisters should have bed-sitting-rooms; a floor space of about 140 sq. ft. should be allowed, therefore two sisters' rooms occupy the spacing of three nurses' rooms. The sisters' rooms should be grouped together so that they may share bathroom and other ancillary accommodation, and be somewhat apart from the other nursing staff.

In some hospitals a portion of a floor is set aside for sick nurses. The Report does not consider a sick-bay in the nurses' home as a normal requirement and considers it much more convenient to treat sick nurses in the ward units. This is a suitable arrangement if there is a sufficiency of small or, preferably, single-bed wards.

When possible night nurses should be grouped in upper floors, cut off from the main circulation corridors into a separate wing. They must be placed away from any rooms which are apt to be noisy, as it is essential that uninterrupted sleep is ensured.

There are a good many types of layout. A zig-zag partition between adjoining bedrooms with wardrobes recessed side by side is favoured by some, but this tends to narrow

the room unduly, and the best position for the wardrobe is generally accepted as on the inner wall facing the window. If these wardrobes are placed between the rooms, they greatly assist in reducing the passage of sound from one room to another; they should be at least 1′ 9″ deep and should extend to the full height of the room. The basin will be on one side of the window, with a mirror alongside. It is interesting to note that a 6′ person can get a full-length view in a mirror 3′ 4″ long by 10″ wide. Fixed shelves for brushes, bottles, etc., should be placed near the basin and mirror, but preferably not above the basin. The window should be kept free for a writing-table. If the bed is to be placed along one wall, it is a good thing to have plywood panelling the length of the bed (see Fig. 34) since it saves the plaster from being marked.

All service pipes in the bedrooms will be carried in the vertical ducts, and it must be remembered to provide access to this duct in each room. In order not to disfigure the room, this can be provided by fixing the lavatory basin to the duct, the front face of which can be removable glazed asbestos sheet normally forming the splashback. The lavatory basin should be fixed clear from the walls on brackets, so that it can be cleaned right round.

The windows should be side-hung casement, with a top-hung window for night ventilation. Above the door will be provided an opening fanlight, so that apart from lighting the corridor it also allows a cross-current of air through the room.

Lighting will be by a central ceiling point and a bedside standard lamp, so controlled that only one light can be switched on at one time, the switch being accessible from the bed. The provision of a safeguarding device to the lamp in nurses' bedrooms as a means of prevention of the illegitimate use of electricity, with possible damage to the electricity system, is recommended.

Heating can be by ceiling panels controlled by a valve at the side of the pipe duct or by a radiator under the window. An electric power plug should be provided for emergency heating.

The height of all bedrooms and private sitting-rooms should be at least 8′, except where determined by the height of other rooms on the same floor.

The nurses' bedrooms at the Macclesfield General Infirmary are well planned. The wardrobe is built against the wall so that recesses are formed on either side, one for the lavatory basin next to the window and the other for the bed. The wardrobe is double, one side being hanging space, the other shelves for linen. Here the bed recess is lined with plywood to prevent marking. The basin is mounted on a wood framing with a recessed toe space, so that all pipes are enclosed. A hot towel rail is provided under the basin, and a mirror, shelf, and tumbler and tooth-brush holder above. A combined dressing-table and chest-of-drawers is provided, as well as a bedside table and full-length mirror.

At the Hospital for Sick Children, London, the sisters' bed-sitting-room contains only a divan bed, chair, and book-case. The wardrobe, chest-of-drawers, fitted basin, heated towel rail, and mirror are all in an adjoining slip of a dressing-room, about 4′ wide (see Fig. 34). These narrow dressing-rooms are in pairs and back to

back, so that two sister's bedrooms still occupy the same space as three nurses' bedrooms.

As previously mentioned, the bedrooms should be tastefully furnished and decorated. At the Hospital for Sick Children, London, the woodwork is Indian white mahogany, stained a warm grey and wax polished. The floors are of jarrah, and the walls papered with a washable paper. An alternative finish is cork linoleum flooring laid direct on to

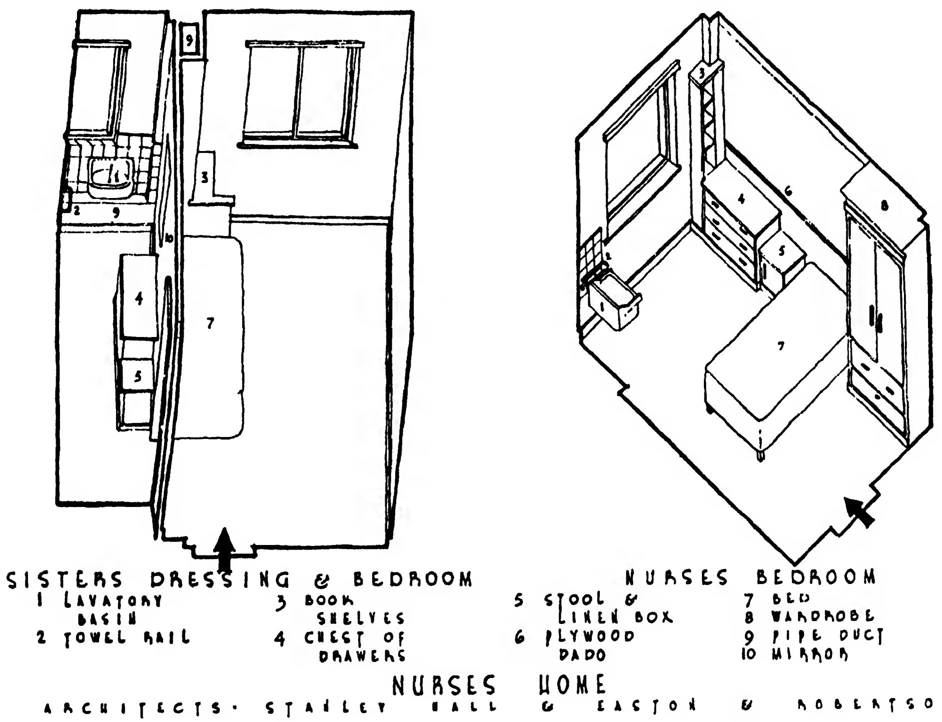


FIG. 34.

concrete and with a terrazzo skirting fitted in order that no vermin may penetrate the rooms, the walls being plastered and distempered with two coats of washable distemper.

Washing and Sanitary Accommodation. It is generally considered that a fixed basin should be provided in each bedroom. The alternative is a row of ablution cubicles in the sanitary section, but these are much less convenient and take up a considerable amount of extra space; and no appreciable saving of cost is likely to be effected if the cubicles are sufficient in number (say, one to four nurses) and are divided by partitions and curtains and of sufficient size.

Other washing and sanitary accommodation should be provided as follows:

a bathrooms (which need not be provided with lavatory basins)—one to six bedrooms;

b W.Cs.—one to six bedrooms, in addition to any sanitary accommodation not on a bedroom floor;
c facilities for incineration;
d facilities for shampooing—in the proportion of one fitting to about fifty nurses;
e personal laundry, drying and ironing all in one room;
f housemaid's closet—at least one on each floor.

Bathroom. Where convenient the bathrooms should be grouped together on each bedroom floor as far as possible in proportion to the number of bedrooms on the floor. The bathrooms need not be large but of a size to accommodate a bath of inside dimensions 5′ by 2′ with sufficient width between the bath and the wall to take a narrow door.

The bath should be built in across one side of the room, and the only other fittings required are a chair or cork-topped built-in seat and recessed soap holder. The panel to the bath should be removable for access to the service pipes, and bath cocks and waste should be 1″ and 2″ respectively, for rapid filling and emptying.

W.Cs. These are usually grouped with the bathrooms, and are better approached from a secondary passage with only a single door from the corridor. One lavatory basin should be provided in each group.

With each group of closets, an incinerator should be provided for the disposal of soiled materials not sent to laundry. There are models with automatic time shut-off device which are so simple that even the most lackadaisical will not seek to avoid using them. The mere act of opening the door to throw in the refuse turns up the gas flame and leaves it so for a predetermined period, after which the gas reverts to a by-pass jet.

Shampoo Room. This room, as its name implies, is for hair-washing. The shampoo basins, at a ratio of one to fifty nurses, should be provided with a flexible shower pipe spring loaded, so that the spray is flush with its panel when not in use (see Fig. 35).

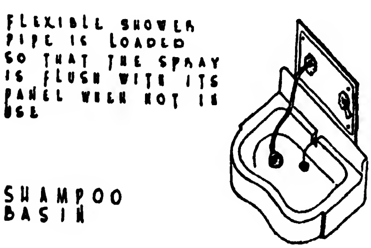


FIG. 35.

Electric shock-proof hair-dryers are generally provided, also a dressing-table and mirror.

Laundry. This small hand laundry is provided for the nurses' private use, whereby they may wash, dry, and iron small personal articles which might spoil if washed in the general laundry.

It should be equipped with deep, double white sinks with large teak draining boards for washing, a large whitewood ironing table and ironing boards, and a cupboard for the storage of electric irons. Small vertical heated closets should be provided for the drying of articles.

Boot Room. Provide either a bench or room for cleaning boots and shoes.

Tea-pantry. This pantry is normally provided on all floors to allow nurses to provide themselves with a light meal, if desired, without leaving the bedroom floor. A tea pantry is also required on the sisters' floor.

Storage. The question of storage must be carefully considered, so that everything has its proper place in the building and no rooms are cluttered up with unnecessary articles. Doors of these storage rooms should be sufficiently wide to admit of large laundry baskets and trolleys.

On every floor linen and blanket rooms should be provided to facilitate easy distribution of bed clothing. A favourite distribution is to provide the main stores near the lift or on the ground floor, with cupboards on each bedroom floor and in proximity to the mess-rooms when appropriate. The rooms should be heated and fitted with slatted shelving from floor to ceiling ranged on either side of a central aisle. The shelves should be 1′ 4″ apart and 1′ 10″ deep, and give an allowance of 1′ 1″ of shelving per person.

Large box-rooms are placed on every floor to give nurses ready access to their baggage. In some homes a large, centrally heated trunk-room is provided in which the nurses' baggage is stored on metal racks. Sufficient racks should be provided to take one small trunk for each occupant.

H.M.C. A housemaids' room should be provided on each floor, and is normally grouped with the W.Cs.

The equipment required consists of draw-off taps and tray, a slop sink, and a cupboard for household utensils, dusters, etc., and provision for refuse pails.

EDUCATION OF NURSES

Although the educational department is not essentially a part of the nurses' home, it is preferable that it should be situated in the home. In a large training school it is usually more convenient to arrange a separate entrance, with a small cloakroom for nurses visiting for classes or examinations.

Training schools should have a preliminary training school (which might well cater for more than one hospital) in which student nurses or pupil assistant nurses, as the case may be, will undergo preliminary instruction prior to entry into the hospital wards.

The adoption of the "block" system of training should be considered as an objective wherever the numbers allow. Small training units should, wherever possible, combine in group training schemes.

The accommodation must be adequate for lectures, for tutorial classes, for private study—including library facilities—and for practical work in the various subjects, which include nursing, cookery, and elementary sciences. In addition, there should be adequate accommodation and facilities for recreation, and also physical training.

The Royal College of Nursing in their memorandum on "Preliminary Training Schools for Student Nurses" emphasises throughout the necessity of adequate accommodation, and states that this can only be determined in relation to the intake of

students and the extent of the existing facilities available for the preliminary training school. This, in turn, is determined—among other things—by the location of the preliminary training school.

The Royal College of Nursing does not recommend that rooms should be used for multiple purposes. For instance, a common room combining facilities for physical training would not be conducive to an atmosphere of rest; the use of the board-room for teaching purposes might, at times result in curtailment or interruption of studies.

The accommodation suggested in the memorandum prepared jointly by the Royal College of Nursing and the British Hospitals Association is as follows. The accommodation suggested is on the assumption that the preliminary training school should accommodate approximately forty to eighty students at a time, smaller units being uneconomical:

- *a* one large classroom to accommodate all the students;
- *b* one smaller classroom;
- *c* one practical classroom of sufficient size to take classes of twelve to fifteen for practical work;
- *d* cookery classroom with sufficient equipment for cookery classes unless this subject is taken outside the school by arrangement with the local education authorities;
- *e* one laboratory for science classes: if this subject is also taken outside the school, a small annexe to the practical classroom should be sufficient;
- *f* one library with facilities for study;
- *g* one recreation room which could be adapted for physical training, a course of which, undertaken by an appropriate instructor, is an excellent preparation for the more strenuous work in a hospital ward;
- *h* one quiet room;
- *i* one office each for the superintendent-sister and the warden-housekeeper, and one large office for the other sisters; or each qualified sister-tutor could have a desk in one of the classrooms and one of the other sisters a desk in the library.

If the recommendations of the Liaison Committee of the Royal College of Nursing and the British Hospitals Association are adopted in regard to preliminary training schools, additional living accommodation as follows will be required:

- *a* the superintendent sister, who should be resident, should have her own flat, i.e. bedroom, sitting-room, and bathroom;
- *b* technical staff, if resident, should each have a bed-sitting-room or separate bedroom and sitting-room;
- *c* the warden-housekeeper, who must be resident, should have her own bed-sitting-room or bedroom and sitting-room;
- *d* separate study-bedrooms for each student nurse;
- *e* dining-rooms for sisters and student nurses.

Lecture-room. This, when required, has an area of 12 sq. ft. for each member of the staff, assuming an attendance of one-third of the number of student nurses.

PLATE XIV. Lecture Theatre
Middlesex Hospital, London

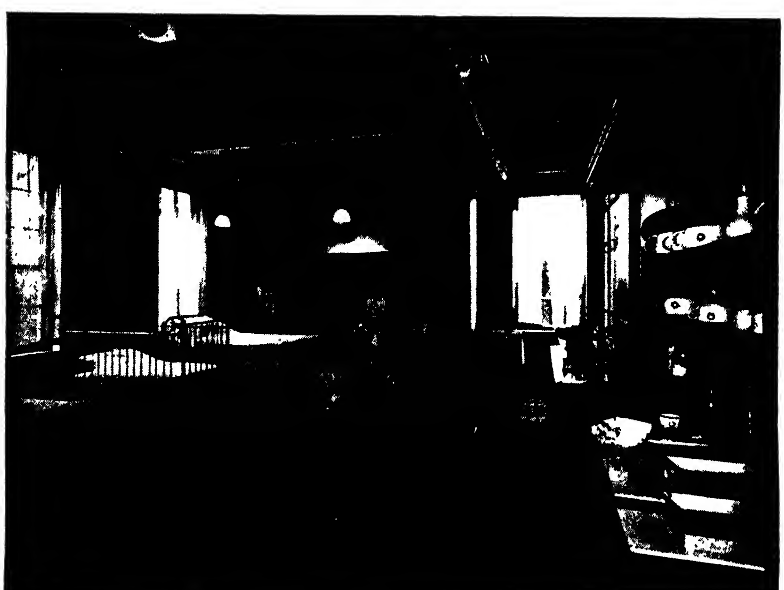


PLATE XV. Demonstration Room
Middlesex Hospital, London

[*To face page 106*

The floor should be raked and fitted with fixed desks, a blackboard is required behind the lecturer's small demonstration counter.

Demonstration Room. This may conveniently be arranged to open off the lecture room, being divided by a folding screen constructed as sound-proof as practicable. The equipment occupies a considerable amount of space, and 700 sq. ft. is considered by The Report as the minimum size for practical convenience. Fig. 36 shows a typical layout.

The following is a list of customary articles of equipment in a demonstration room:

- *a* skeleton
- *b* bones
- *c* models—trunk, eye, ear, head, heart
- *d* charts—anatomy, hygiene, physiology
- *e* hygiene models
- *f* model patients—adult and child
- *g* bandaging models
- *h* bed
- *i* cot
- *j* air rings, pillows, etc.
- *k* ward utensils
- *l* urine testing apparatus
- *m* instruments
- *n* splints
- *o* bandages
- *p* samples of stock medicines, lotions, etc.
- *q* lantern and supply of slides
- *r* supply of linen, mackintoshes, etc.

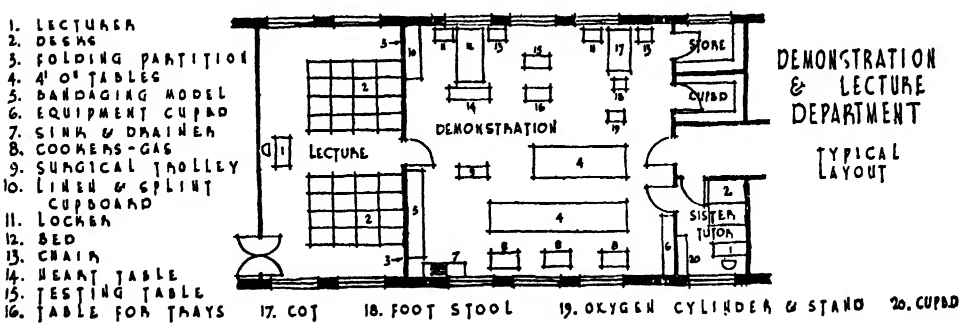


FIG. 36.

The foregoing is for a simple demonstration room. A complete schedule of equipment required in a large central preliminary training school is given in Appendix B of the memorandum prepared by the Royal College of Nursing and the British Hospitals Association.

The demonstration room will sometimes have one part set aside as a cookery section and another equipped for instruction in practical nursing. Any cooking equipment necessary might, where circumstances admit, be placed in a recess or bay.

In small hospitals where there is no alternative the cookery instruction can be given in the central kitchen and the demonstration room reduced accordingly.

Sister Tutor. An office with an area of about 100 sq. ft. should be provided for her, and adjacent thereto a small reference library and a store and cloak room.

Maternity. Special demonstration room is required for tutorial classes in maternity practice. This may be incorporated in the maternity department.

FINISHINGS

Finishings and equipment should be selected to give a minimum amount of trouble, and thus reduce maintenance charges to a minimum; for example, no chromium plating, copper, or similar tarnishing materials should be used; cupboards to be structural and not of plywood construction.

Throughout, the finishings should be selected to give the building a definite domestic and homely character, so that it offers a complete mental rest from the surroundings of an institutional building.

As an example of the class of finishings required, the following is given:

Floors. To staircase halls, corridors, bathrooms, closets, laundry, and tea-pantries can be in cream terrazzo. The treads and risers to the staircase require a non-slip abrasive surface and the corridor floors can be divided up into rectangles (4′ by 3′ 6″) with ebonite expansion strips.

To the common rooms, teak boarding or jarrah dowelled blocks polished and laid in basket pattern with a plain margin in a lighter colour are pleasant. To bedrooms, office, box, and linen rooms an alternative can be Austrian oak, polished and also laid in basket pattern. For cheaper finishing, linoleum laid direct on cement screeding is suitable for bedrooms, corridors, and similar.

Walls and Ceilings. Generally to be plastered. Staircase halls, soffit to stairs, corridors, bathrooms, to be painted matt; also all common rooms.

The bedrooms to be treated with washable paint or enamel up to picture rail, and light tint used for all paint-work and in a general way for all movable furniture, special regard being given to the general colour-scheme of the walls, furniture, bed coverlet, etc. Linen and box-rooms to be distempered, and W.Cs. and H.M.Cs. to have painted walls and distempered ceilings.

12

The Central Laundry

THE LAUNDRY is not an essential part of a hospital, and it is not unusual for the washing of a general hospital to be done at the laundry attached to another hospital or institution (for example, a mental hospital or poor law institution), and some municipal authorities have established independent group laundries to undertake the laundry work for a number of institutions.

The provision of laundry accommodation depends upon many factors: cost of buildings, local cost of labour, type of hospital, magnitude of weekly wash, cost of transport, and possibility of useful employment of inmates, etc., and therefore it will be seen each case should be dealt with on its merits.

In recent years the laundry machinery manufacturers have developed types of machinery especially designed for the hospital of fifty beds and upwards. The economies due to the prompt return of linens, the advantages of adjusting the processing to the special needs of hospital linen, and the increased life of the linen itself all favour the hospital doing its own work.

Any of the leading laundry machinery manufacturers are sufficiently familiar with hospital requirements and are glad to advise as to proper layout. Such recommendations should be secured in the preliminary planning stage in order that the architect may include proper provision for drains, water, steam, and electrical service connections.

PLANNING

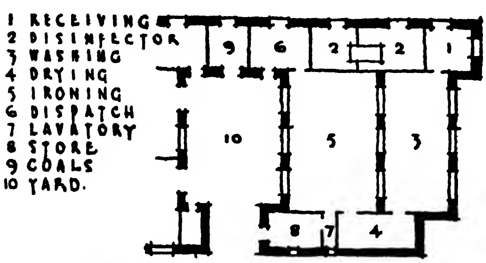
If a laundry is provided, it should be situated in convenient relation to the central power-house to avoid running long lengths of high-pressure steam and condense hot-water mains, which are costly to install and involve heavy radiation losses. The size and planning of the laundry will depend on the number of articles to be washed and the equipment necessary for the purpose. The weekly wash per patient will vary from fifteen articles per week per inmate in an able-bodied male institution to forty-five articles per week per patient in a smallpox hospital, so that it is necessary to determine the extent of the weekly wash before the size of the building and the type of plant can be arrived at.

In America it is considered the average hospital produces 12 to 16 lb. of soiled linen per patient per day, though some large city hospitals may fall as low as 8 lb. and some de luxe or teaching hospitals may go as high as 22 lb. But this is for 7 days per week

while the laundry normally operates but 40 to 44 hours per week and laundry machinery is usually rated in terms of pounds of capacity per hour. Thus an average of 15 lb. per patient per day means 105 lb. per week and will thus require a laundry capacity of 2½ lb. per hour per patient. All must be washed, but the finishing falls into three categories approximately as follows:

a 5 per cent. for hand or press finish;
b 20 per cent. for rough dry;
c 75 per cent. for flat work.

The Report wished to give information as to the appropriate floor area required by the laundry, but found on investigation of existing hospital laundries and from statements furnished by the manufacturers of laundry equipment that there was such a wide variation of opinion that it was not possible to recommend a standard. The London County Council consider the rough approximations of the floor area required will vary from 210 sq. ft. per thousand articles washed per week with a weekly wash of sixty thousand articles to 250 sq. ft. per thousand articles for a weekly wash of ten thousand articles, and the area will be sub-divided approximately as follows:



LAUNDRY DEPARTMENT
SCARBOROUGH HOSPITAL
ARCHITECT: W. MARCHMENT

FIG. 37.

a 10 per cent. for receiving rooms (foul 2 per cent., general 4 per cent., staff 4 per cent.);
b 35 per cent. for washhouse;
c 12½ per cent. for drying-rooms;
d 30 per cent. for ironing-rooms, including superintendents' office and store;
e 12½ per cent. for sorting and despatch (patients 6 per cent., staff 6½ per cent.).

Figs. 37 and 38 indicate plans of two laundries constructed prior to the 1939–45 war. The building should be designed as a modern commercial laundry (see Plate XVI), comprising one large department for all purposes (except foul washing, disinfecting, etc.), the side walls of which should be mostly windows and also with large top lights, such system allowing for the fullest supervision and the easiest of working arrangements. Two important points to be remembered are, to see that all doors to working units are sufficiently wide to take trolleys, and that if water contains more than 10 degrees of hardness it must be softened, necessitating water-softening plant.

The laundry should be self-contained, and as it is necessary for a complete separation of dirty and clean linen to be effected, the dirty linen should be delivered from the hospital or staff quarters to the receiving rooms, where it is sorted—the linen regarded

as infected must go through the disinfector before reaching the receiving room. Here, again, the correct cycle of operations should be carefully considered in the planning: the linen is sorted in the receiving rooms and then passes through the washing unit to the drying chamber and into the ironing-room, after which it is again separated in the sorting room. The layout of the building and machinery is designed accordingly on the principle of circulation of work, that is to say, articles to be washed are taken in at one end of the building, whence they progress in a continuous direction through the various units in such a way that no individual piece of washing has to return over the ground from which it has come. The diagrammatic sketch (Fig. 39) indicates the circulations required.

An office, situated with observation into the main units, and stores for soda and

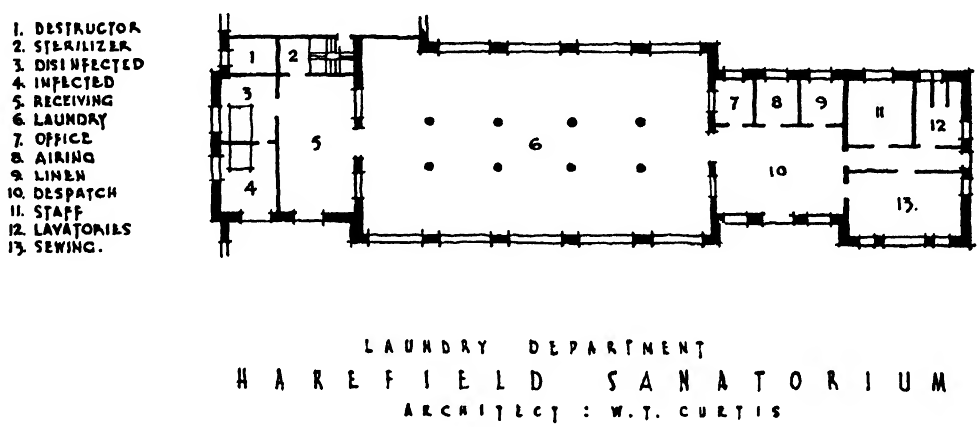


Fig. 38.

washing materials are required. Accommodation for sewing-room and staff-rooms with toilet can be designed as an annexe to the main building.

When sufficient land is available, a large open space adjacent to the laundry should be used as an open-air drying ground when suitable weather conditions permit.

DISINFECTOR

Where required it is used mainly for disinfecting mattresses and other materials not always washed (clothes, blankets, dressings, etc.), and in large schemes it is not included in the laundry department, as there is a tendency to put linens which should be disinfected in the foul wash through the apparatus. In such cases there is normally a separate lift circulation with the disinfecting plant in the basement.

In small schemes the plant is part of the laundry in order to avoid duplication, and the infected linen passes through it before reaching the receiving room. A separate circulation in connection with it is nevertheless required, and in this case full-size

plant capable of handling mattresses and similar large articles should be sited with easy approach.

The actual apparatus is a steam-operated cylinder about 4′ in diameter and 7′ long, opening at each end into separate rooms, one for infected and the other for disinfected linen; these rooms must have no connection with each other except through the apparatus. The dividing wall has an observation window on either side of the plant. Ample space must be allowed at each end for the removal of long articles; the two rooms should be at least 12′ wide and have a total combined length of about 30′ with a height of at least 9′.

In special cases such as a large smallpox or fever hospital, two disinfectors are usually required.

ACCOMMODATION

Receiving. Separate receiving rooms for patients', staff, and foul clothes are required. They are equipped with open bins which are placed around the rooms, and into which the various articles are sorted from a central table.

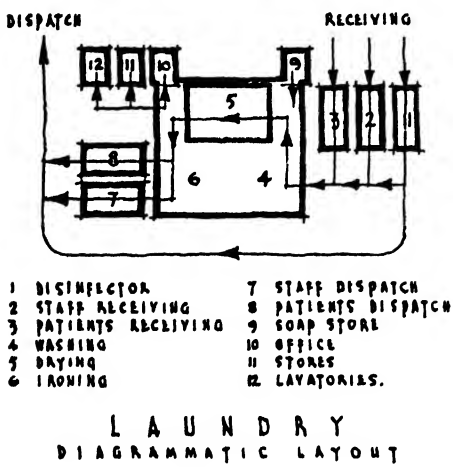


FIG. 39.

Washing, Drying, and Ironing. This is, in fact, the focal point of the laundry, containing the washing, drying, and ironing units, the last being more spacious than the others as it is here the clothes tend to accumulate.

The general equipment of this section will consist of the following plant, and the full requirements of the Home Office must be complied with in the matter of protection of machinery.

a *Wash-house.* Steeping tanks, soap and soda coppers, washing machines, hydro extractors, starch boiler, and hand-washing vats. The washing machines of the modern type are arranged in line and driven from line shafting which can be instantly stopped by means of a switch above each machine, so that in the event of an accident all the machines driven by this shafting may be immediately stopped. The hydro-extractors are each driven by their individual motors.

The size and number of machines will depend on the number and weight of articles washed per week, but generally there should not be less than four washing machines and three hydro-extractors, which allows one washing machine and hydro-extractor for foul work, two washing machines and one hydro-extractor for general work, one of the washing machines being fitted with

interrupter gear for flannel washing, and one washing machine and one hydro-extractor for staff work.

Minor mixing and boiling apparatus is required for soap, soda, and starch.

b *Drying-room.* Drying horses or continuous drying machines. Drying facilities are provided by means of a continuous dryer, heated by steam-heated coils and electrically driven air-circulating fans within; from this machine articles emerge sufficiently dry for use or for hand ironing as necessary. In addition, large calenders are provided for drying and finishing the larger articles.

A large drying closet with a blanket-airing room is desirable. Spare space above this closet and the linen room can be partitioned off to provide extra storage accommodation.

c *Ironing-room.* Ironing machines, steam presses, collar finishing machines, glad irons, and gas or electric irons together with skirt boards, etc., are the usual equipments.

Despatch. After ironing, the articles are again sorted into racks for each department of the hospital or staff. These rooms should be about the same size as the receiving rooms. Some laundries make provision for airing the linen before it leaves this unit, while others rely on airing being done in the general linen rooms of the various departments.

Ventilation. If laundry buildings are designed with ample height and plenty of top and side window ventilation, the use of mechanical ventilation will rarely be required. On hot, humid days, however, some form of mechanical ventilation may be necessary and the plenum system, with air inlets about 1′ 6″ from the floor and properly spaced, will be more satisfactory than an extraction system. If the laundry is well ventilated naturally the system requires all windows to be shut.

Six to eight changes of air per hour are recommended with air introduced at floor level. The ventilation is not a question of the chemical purity of the air, as in crowded rooms, but of the physical reactions of individuals in overheated and very humid air. Consequently, ventilation should be designed to produce circulation of currents of air around the workers.

Services. An ample supply of hot and cold water is required and services to machines should be large enough to avoid waste of time in filling them up.

High- and low-pressure steam must be provided, the former of at least 70 lb. per sq. in. pressure for ironing machines and the low-pressure steam at 20 lb. per sq. in. for washing machines and drying apparatus. It should not exceed 3 lb. per pound of laundry. The laundry operates only about 40 hours per week, and rather than install high-pressure boilers merely to meet the laundry need it is entirely feasible in a small hospital to use either gas-heated laundry equipment or a small independent high-pressure boiler for the laundry only.

The questions of hot-water supply for washing and steam or other heat for finishing

have been discussed under appropriate titles in Chapter 37. Consideration from the point of view of the cost of the energy used to drive the laundry machinery—electricity or the steam-engine—the steam-engine, the exhaust from which may be applied to heat water or for other purposes—the latter is found to be invariably the cheaper. In an electrically driven laundry, however, any unit may be operated independently of the others.

There are two conservation measures that should be considered in the planning of the steam and hot-water supply and return. The washers discharge from 2½ to 4 gallons of hot water per pound of clothes washed. This water is at an average temperature of approximately 125 deg. F. Much of this heat can be saved by placing in the waste channel a heat exchanger. This is simply a receiving tank in the waste channel containing a coil through which cold water on its course from the main to the hot-water heater is passed and during its passage through the coil absorbs heat from the surrounding hot discharged waste water. This tempering of the water may amount to as much as 25 deg. F. or more.

Another possibility is the use of a heat reclaimer. The flat work ironer is heated by steam at 100 lb. pressure—a temperature of about 335 deg. F. The steam return pipe from this equipment is usually fitted with a steam trap to prevent steam from "blowing through" before it has condensed and had thus given up its maximum heat. But even after it has condensed the water is still at a temperature in excess of 300 deg. F. and will boil as soon as it is exposed to atmospheric pressure—which usually happens in the waste channel. The heat reclaimer is a device for conserving the heat given off during this stage until the water has reached a temperature below the boiling-point at atmospheric pressure. It is essentially a water receiver containing a coil surrounded by water on its way to the water heater. The super-heated condensate from the steam-heated equipment passes through the submerged coil and gives up its excess heat to the surrounding water, and incidentally reduces its own temperature to or below the boiling point.

FINISHINGS

The Report is of the opinion that the floors should be of granolithic and the walls salt-glazed bricks or engineering bricks up to a height of 4′ 6″, with ordinary brick above.

The floor of office and sewing rooms can be of wood blocks.

13

The Garage Facilities

THESE UNITS need very careful placing, otherwise they will spot the plan unduly. Each relates peculiarly to other buildings on the site, and communication must be carefully considered.

Garages. These are required for the ambulances and staff cars and must be provided. It is as well to include with them an oil store and petrol pump.

To form the garage, the administration department could be carried on columns, so that the ground space under it is free. Projecting canopies avoid noises penetrating to the rooms above. The cars are parked on the ground under it and are garaged in underground garages, which are approached by concrete ramps.

Bicycle Sheds. A number of hospitals, especially those in rural and semi-rural districts, will require provision for bicycles for a proportion of the visitors. The actual racks will be standard fittings made by specialist firms, and the accommodation should be close to the porter's lodge for general supervision. The porter may provide individual padlocks for a small fee.

14

The Mortuary

In even the smallest hospital, a mortuary with a suitable small viewing room or lobby and post-mortem room should be provided. It must, of course, be not only in an obscure position, but also accessible for the hearse, and is usually provided with an independent approach and exit so that the removal of the dead may be effected as unobtrusively as possible. In large schemes it is often connected to the other departments by a subterranean passage (the service subway), this is convenient in order to have easy communication with the receiving unit in the out-patients department and the laboratory.

PLANNING

The extent of mortuary accommodation required varies according to the prevailing types of cases admitted to the hospital, but an average acute general hospital requires

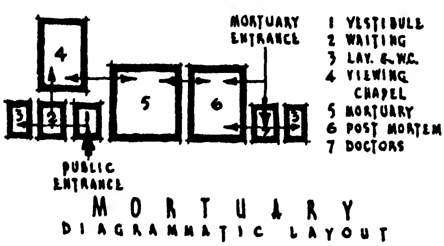


Fig. 40.

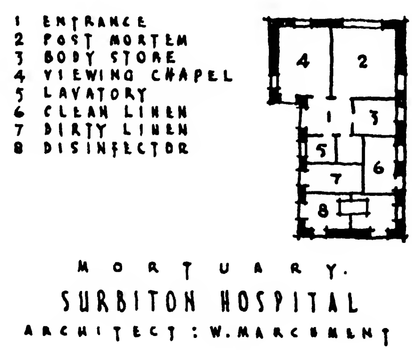


Fig. 41.

mortuary places in the proportion of 3 to 4 per cent. of the number of patient beds. Unfortunately, increased mortuary accommodation may be needed at some future date, so that compartments built two tiers high in the first instance can be increased by 50 per cent. by adding a third tier without further extension to the building, but in the layout, room for expansion must be planned.

The department contains three main rooms, of which the mortuary and post-mortem room should have northerly aspects, the viewing chapel aspect being less important.

The diagrammatic sketch, Fig. 40, indicates the circulation required, Fig. 41 an immediate pre-war mortuary, and Fig. 42 a typical layout.

ACCOMMODATION

Mortuary. A convenient arrangement is a rectangular room—size 300 sq. ft. for twelve bodies in two tiers—with a series of compartments in two or three tiers ranged along one wall. It is most important that sufficient space should be left:

a in front of cold-storage chambers to slide trays easily and to have space to turn them;

b round the doorways for entrance of trolleys, trays, coffins, etc.

The depth of the room from back to front should not be less than 17′ for one row to allow easy manipulation of trolleys, the other dimension will be determined by the number of the places required at width of 3′ centre to centre when refrigeration is

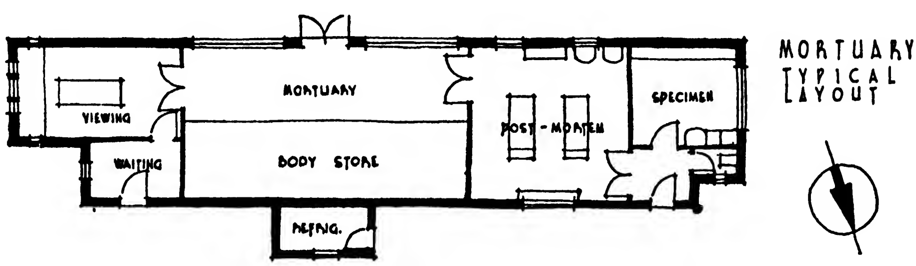


FIG. 42.

installed. Manufactured is a four-bay rack, three tiers high (twelve body trays), these racks can be supplied in single three-tier units of any number of bays, the body trays with skids on underside run in grooves on 2″ dia. rollers on ball-bearings. Alternatively, the bodies are placed on slabs of terrazzo or slate biers at spacing 6′ 6″ centre to centre.

The room should be well ventilated with windows at high level. In some mortuaries ventilation is effected through gratings in the ceiling with natural circulation between ceilings and roof ventilator, or by ducts in walls, with gratings suitable to each room, for electric air-exhausting fan.

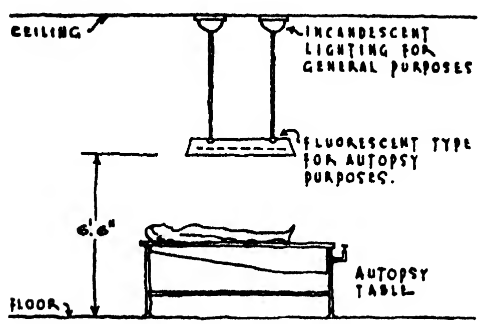
Although some cold chambers are necessary, it may not be essential to provide refrigeration for all the bodies for which accommodation is provided, as the heavy death rate is usually in winter, when refrigeration is unnecessary. If economy is insistent the amount of refrigerating space may be reduced so long as it is sufficient to accommodate at least half the bodies. The refrigeration should be installed in such a manner that it can be applied to separate sections.

A small chamber (about 20 sq. ft.) adjoining is required for the refrigerating plant, which should be fitted with automatic stopping and starting equipment. The plant should be designed to work to minimum and maximum limits of 37 deg. and 40 deg. F. Alternatively the refrigeration referred to in Chapter 8 can be used here as well,

provision must therefore be made in such case to admit of the circulation of brine for the cells of the cold storage unit.

Post-mortem (*Autopsy*). The room should have an area of 300 sq. ft. for one table or 400 sq. ft. for two, and should adjoin the mortuary, with small room for instrument cleaning. Staff toilet facilities are necessary.

Good side-light is important, with the addition, if possible, of top-light. It is obvious that good natural ventilation of the post-mortem room is required together with artificial light. In autopsy work a high level of illumination is required, the usual arrangement requires high wattages immediately over the heads of the workers. This generates much heat which not only produces discomfort but likewise accelerates the generation of odours. A type of fixture using fluorescent lamps is required (see Fig. 43). Some means of heating should be provided for the comfort of the staff conducting examinations and a hot-water service to the hand basins is required.



LIGHTING TO P.M. ROOM

FIG. 43.

It should be fitted with a central table, well drained, with a hose connection attached. A large sink with a fireclay slab, lavatory basin, and slate or glass shelves are also required.

Viewing Room. This room is used for relations viewing the deceased and occasionally for juries in connection with inquests. The room—about 180 sq. ft.—oblong in shape (18′ by 10′) should be fitted for devotional purposes and, if possible, with an east window. It should be entered from both the mortuary and the waiting-room.

A small waiting-room—70 sq. ft.—is desirable, with toilet facilities for visiting relations.

Office. In large mortuaries, a room should be provided for the mortuary assistant, which he can use as an office for the keeping of records, etc. If necessary, as a measure of economy, this room might also be used for the purpose of keeping post-mortem specimens instead of allocating a separate room for the purpose.

FINISHINGS

The floor to mortuary and post-mortem rooms should be tiled or of terrazzo laid in squares with a cove against the walls, and the walls of the same materials to a height of at least 6′ 6″; the floor should fall to one side where a channel should be formed for sluicing purposes. Some authorities object to tiling from an acoustic point of view, as with tiled walls there is apt to be an echo.

The floor of the viewing room should be of hardwood, with painted plaster walls above a tiled dado.

PLATE XVI. Laundry
Hospital Centre, Birmingham

PLATE XVII. Autopsy
Hillingdon Hospital

[*To face page 118*

PLATE XVIII. Out-patients Waiting Hall
Edgware General Hospital

To face page 119]

SECTION IV

Medical—Detailed consideration of the several departments necessary for an acute general hospital

15

The Reception and Out-patient Department

THERE is a growing demand for hospitals, even in the smaller communities, to make some provision for the care of ambulant patients even though it is not as comprehensive or as elaborate as that provided by the out-patient departments of teaching or other large hospitals. This is a development of the health centre idea, that the hospital should serve as a focal point for the medical care of the entire community. Irrespective of the extent to which the hospital desires to assume this responsibility, such facilities as are provided should not only be planned on a functional basis comparable to that used in planning the in-patient services, but they should likewise be so planned as to secure maximum convenience of the facilities most commonly used by both.

Those facilities common to both are primarily the clinical laboratory, the radio-diagnostic department, and the dispensary. Since it is common practice to provide a separate entrance as well as separate space for out-patients, the general principle governing the placement of these common facilities is that they be interposed between the out-patient area and the main floor area of the in-patient section. The mutual arrangement will vary with the general design of the structure and the amount of traffic, but the general guiding considerations will be the separation of the two groups of traffic and convenience of the common facilities for use of both.

The out-patient department should be mainly consultative. Time spent in hospital can often be shortened if treatment can be continued after discharge. In most hospitals beds are most in request during the winter months. On the other hand, there are many less urgent operations that can be undertaken equally well in summer or winter, and some (e.g. for nose and throat infections) that are much better done in spring or summer. It is disappointing for a patient to be admitted to hospital and then discharged and told to wait, and much better if he can be seen at the out-patients department and admission for operation arranged at a time mutually convenient.

A well-organised department should fulfil the following functions, namely:

a the reception department, where patients for admission to the hospital can be examined: the medical officer conducting the examination should be thoroughly conversant not only with the resources of the particular hospital at which he works but also with the facilities provided by the local authority's health services and the voluntary medical agencies in the district; this will

enable him to refer to the appropriate clinic, hospital, institution, or agency, patients who either do not require hospital treatment or whose condition could be better met elsewhere; in a voluntary hospital the patient has already been seen in the out-patient department and medically examined when summoned for admission, and therefore goes straight to the ward and is then seen by the doctor after having been bathed and put to bed;

b the consultation centre for special investigation and treatment which cannot be efficiently given in the home, but does not necessitate the admission of the patient to hospital, and to which patients from the local authority's clinics may be referred;

c the casualty department, where emergency treatment is rendered;

d the centre, at which continuation treatment is provided for patients who have been discharged from hospital, or for patients who are under out-patient treatment after consultation.

In planning the reception and out-patients departments, consideration should be given to their situation in relation to:

a special departments, which may be common in use to in-patients and out-patients (e.g. radio-diagnostic and physiotherapy);

b casualty;

c dispensary;

d ancillary departments, which may be common in use to in-patients and out-patients;

e ward departments.

and to the traffic approaches:

a one only, or

b separate for reception, out-patients, and any other special ones (i.e. maternity, venereal disease, etc.).

For the purpose of description it will be more convenient to consider the reception and out-patients departments—with their many sub-divisions—separately.

The size of the departments and units required therein will vary considerably in every case. A schedule of requirements has been prepared by the Building Centre Hospitals Committee in conjunction with the Central Bureau of Hospital Information for an out-patient and casualty department for an acute general hospital of about two hundred beds. This schedule is designed in a form which can be filled in by any hospital authority to indicate its requirements.

RECEPTION DEPARTMENT

This department is open at all hours of the day and night, and accident and other emergency cases brought to the hospital by police ambulance or others pass through it before being sent to the wards or sent home (see Figs. 44 and 45). Accident cases need

prompt attention, as they are often brought into the hospital by excited relatives and any delay in receiving and caring for them is likely to subject the hospital to severe criticism. In most cases the patient is not in as serious or dangerous condition as his attendants assume, but this does not remove the sting of public criticism. Likewise these patients are quite likely to be so dishevelled, dirty, and noisy that arrangements for their reception and immediate care should be as unobtrusive as possible. The department in a municipal hospital serves as a combined reception unit

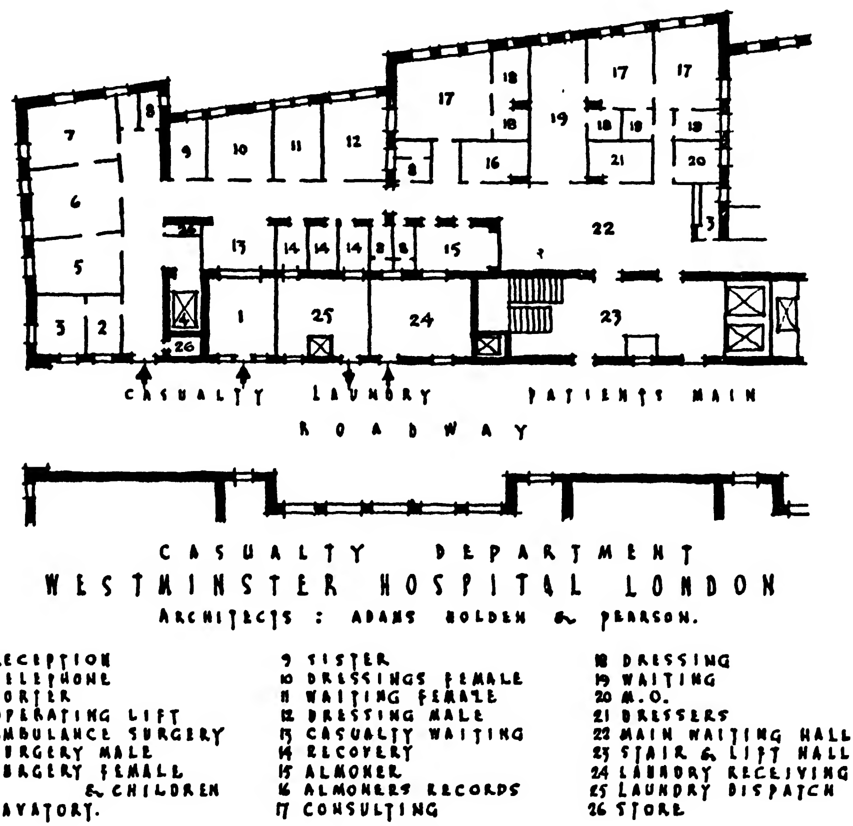


FIG. 44.

and casualty department. It should be explained that the word "casualty" is generally, though not always, used to cover all cases which arrive at the hospital for the first time, and not specifically for accident cases. Most accident cases are casualties, but all casualties are not accidents. It might be said that here the patients are first diagnosed and given their medical history sheet.

The department is supervised by a casualty officer, either a resident surgeon or a physician. The reception department should be planned adjacent to or in the out-patients department. There is a considerable advantage in the reception being situated in the out-patients department, whereby all patients, including casualties, whether

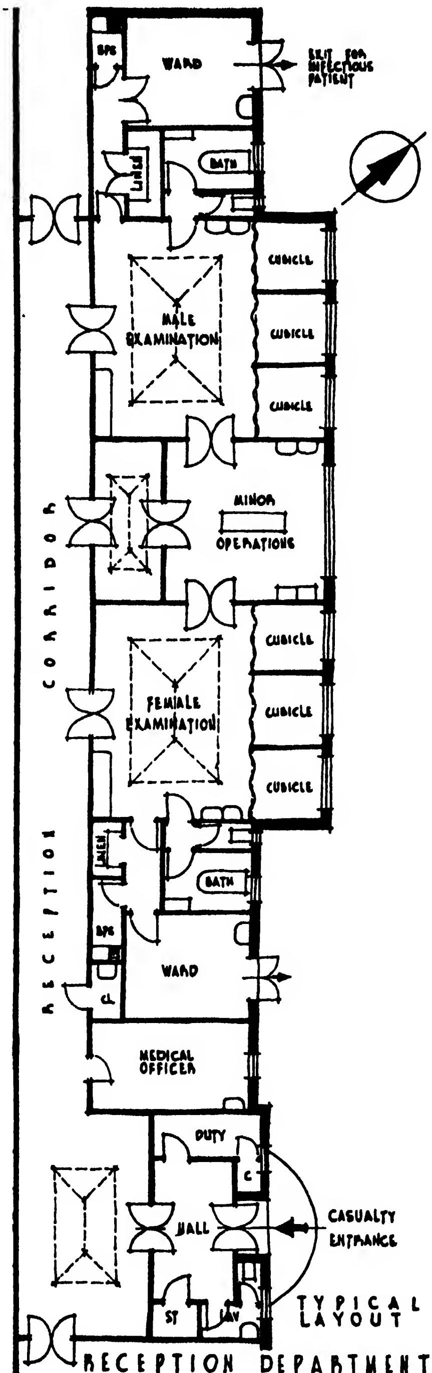


Fig. 45.

they require minor dressings and treatment or need admission to a ward, proceed through the out-patient and receiving department, planned and otherwise provided with all that is needed for examination on admission or first-aid treatment.

PLANNING

Although the reception is generally planned in close relationship with the out-patient department proper, it should have a separate entrance provided with a draw-in for ambulances and an easy ramp for access by bathchair or stretcher.

The department should be separated from the ward departments, but connected to them by the main circulating corridors. The best situation is somewhere on the north side and in close proximity to the special departments (i.e. radio-diagnostic, physiotherapy, etc.).

A small receiving room and at least two examination rooms are necessary. Where the number of admissions warrants it, the examination rooms may be sub-divided into cubicles. At least one single-bed ward is desirable, and this should have a separate exit for the removal of an infectious patient to an isolation hospital, or a deceased patient to the mortuary, without having to pass through the communicating corridor.

There should be sanitary provision, including at least one bathroom, space for a sink and steriliser, and a bay or recess for a wheeled stretcher. A nurses' room and a room for surgical dressings and minor operations should be provided.

The Report states that the following rooms and dimensions are suitable:

a waiting-room
b examination room—200 sq. ft.
c examination room—150 sq. ft. if undivided

d examination room—270 sq. ft. if divided into two cubicles
e examination room—340 sq. ft. if divided into three cubicles
f nurses' room—30 sq. ft.
g surgical dressings room and minor operation theatre—230 sq. ft.
h single-bed ward—110 sq. ft.
i bathroom—100 sq. ft.

The Building Centre Hospitals Committee consider the following are necessary:

a waiting-room
b accident-room
c medical-room
d observation-room
e surgical-rooms
f nursing-staff accommodation
g operation (minor) suite.

The London County Council considers there should be two wards (one for each sex) with sanitary sections adjoining.

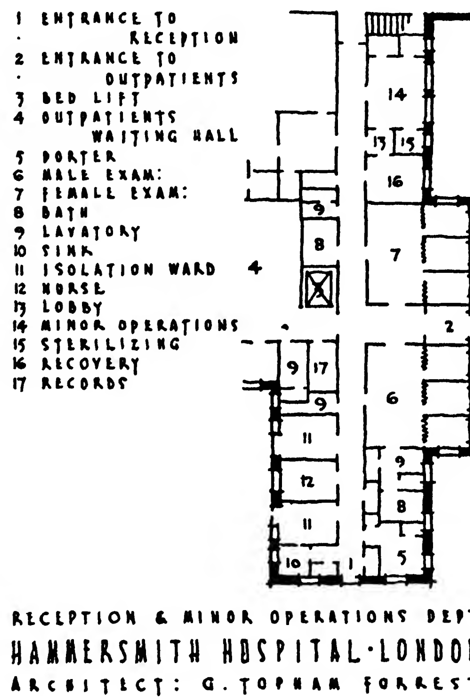


FIG. 46.

ACCOMMODATION

Receiving and Examination Suite. This should be planned so that out-patients cannot see patients being brought in. It should also have easy access to the minor casualty theatre and the various wards.

The room should have cubicles at least 8′ by 6′, one of these having a separate exit for an infectious patient. The equipment will consist of a lavatory basin and sink, to which may be added a fire-clay slab about 2′ by 6′ long fitted with sprays.

Adjoining the examination room will be a small store for dressings, splints, bandages, etc.

Minor Operation Theatre. This should be planned and equipped in much the same way as the theatres attached to the main hospital, but in a manner adapted for minor general operations.

Wash-up facilities in the form of surgeons' basins and a sink may be in the theatre, but a separate small sterilising-room should be arranged directly adjoining. The anaesthetic-room, with an area of about 80 sq. ft., should lead into the theatre by means of folding doors.

Recovery Room. Some authorities consider that this is required for patients to rest after minor operations. To accommodate twelve folding benches an area of 600 sq. ft. is required, and at least two lavatory basins should be provided, with a closet for each sex.

OUT-PATIENT DEPARTMENT

This department is a wonderful "prevention." It is desirable that the out-patients department of important hospitals should only be used for consulting work and not for the minor ailments that can be dealt with in local clinics. This will mean a gradual reduction in the proportion of out-patients to the population served, and will make possible the tightening up of the planning of the department.

The out-patient department is open at fixed times, mainly for consultation and for supervision and treatment of patients who have been discharged or may be admitted to the hospital. Medicines may also be supplied from this department, as apart from the inconvenience of the patient in having to trundle around to the shops, many of the prescriptions are for rare medicines, some of which it is extremely difficult, if not impossible, to obtain under National Health Insurance. In the interests of the convenience of the patient alone, it is reasonable that the hospital should supply the medicine as well as the prescription, and, incidentally, can do it much more cheaply.

The main function of this department is the diagnosis and treatment of persons whose diseases are not such as to confine them to bed. In the absence of a well-equipped out-patient department to carry out the investigations, the patients must be admitted to the hospital unnecessarily.

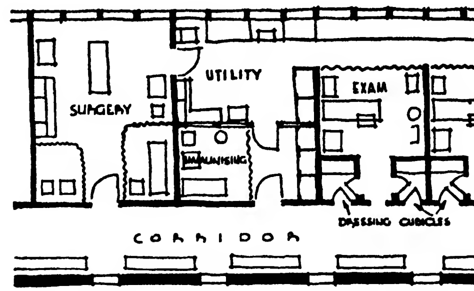
Large numbers of people are dealt with daily, and the planning of the department is one of the most difficult of hospital problems; it contains numerous groups of consulting rooms:

- *a* surgical
- *b* medical
- *c* radio-diagnostic
- *d* ear, nose, and throat
- *e* dental
- *f* orthopaedic
- *g* physiotherapy
- *h* dermatology
- *i* urology
- *j* gynaecological
- *k* deafness (which, strangely enough, needs a sound-proof room owing to the delicacy of the instruments used)
- *l* cardiagraph rooms
- *m* laboratory facilities

The general practitioner has not the facilities available for diagnosing all the many ailments, and therefore a large number of patients who could be treated in their own homes are necessarily referred by him to these units, solely for investigation.

The difficulty of organising out-patients work in the past and the fact that the department has had to be built to suit the varying requirements of a number of honorary specialists made co-ordination a very difficult task. It must be remembered that every consultant thinks that his own unit is the most important, and therefore the building committee must decide on the relative necessity and priority of each.

There has in the past, in most cases, been no control over the number of patients visiting at any particular time, with the result that very heavy "peak loadings" of accommodation occur at certain times of the day. This is a very difficult problem, because, to see so many patients in a very short space of time, everything in reason must be done to facilitate the handling of them with the least possible waste of time—theirs or that of the honorary and resident or stipendary staff. As there can be neither the accommodation nor the staff to meet the requirements at such a time, patients must often be kept waiting a very long period. Unfortunately this has been a feature of out-patients departments in Great Britain, and therefore the appointments system is strongly recommended. It is quite practicable if adequate clerical assistance is provided, and if the medical staff are reasonably punctual.



CONSULTING ROOMS
TYPICAL LAYOUT
FIG. 47.

PLANNING

The entrance should be separate from that of the hospital proper, but convenient to the most commonly used street traffic routes. The interior arrangement should provide for receiving room with early segregation of the two types of patients—"new," who must be registered, pass through social service (almoner) and are assigned to the proper treatment rooms, and "return" patients who may go directly to the treatment rooms by which they are being treated. The traffic routes of the two groups rejoin after leaving the treatment or consulting-rooms, but may again be separated into those who are referred to the laboratory or the radio-diagnostic department, those going to the dispensary, and those who are leaving directly. This precaution of traffic separation will not usually be important in the smaller out-patient department, but when the department deals with two hundred or more patients per day it will be found to facilitate the work of the department very much. In general, it can be expected that about one-fourth of the out-patients will be new, and therefore require registration, almoner investigation, and enough "snap" diagnosis to determine the unit to which they should be assigned, while the return patients have simply to be directed to the unit to which assigned.

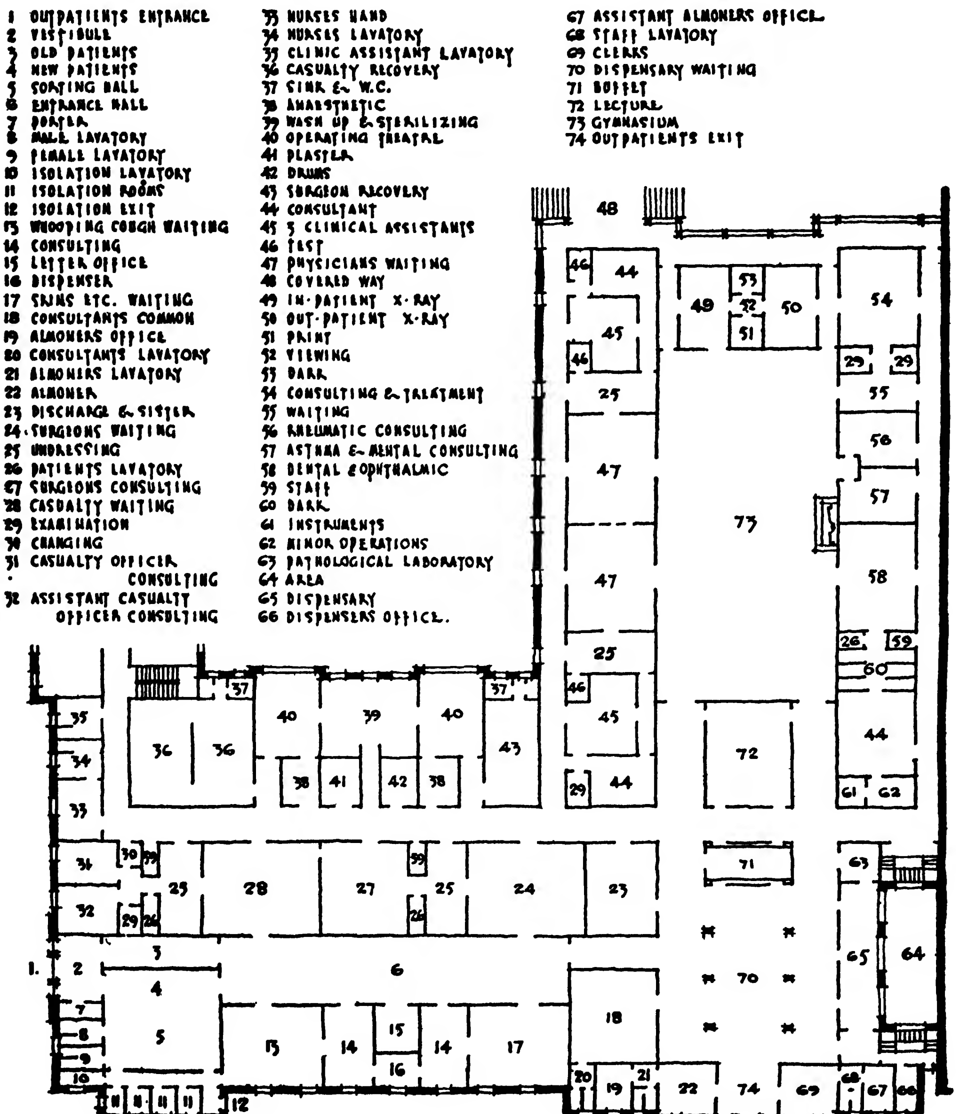
Therefore the main essential features of the plan are as follows:

a main entrance provided with porter's reception, telephone kiosk and separate entrances to the casualty and receiving unit, as well as the ante-natal, venereal disease, tuberculosis, and other units;

b casualty and receiving unit;

c dispensary with its waiting space situated on the out-going exit and at the junction of the out-patient and reception departments, with separate serving hatches for out-patients and for conveniently supplying the in-patients;

d radio-diagnostic and physiotherapy departments. The hospital laboratory is also conveniently located in this area. All these would serve the whole hospital as well as being available for out-patients.



OUTPATIENTS DEPARTMENT
ARCHITECTS: STANLEY HALL, EASTON & ROBERTSON

FIG. 48.

The planning problem of the out-patients department is largely one of circulations. In the past the central feature of the plan in British practice has been the provision of a large waiting-hall with the various consulting-rooms opening out. The patients are roughly classified to sit near the consulting-rooms to which they are allocated, this is

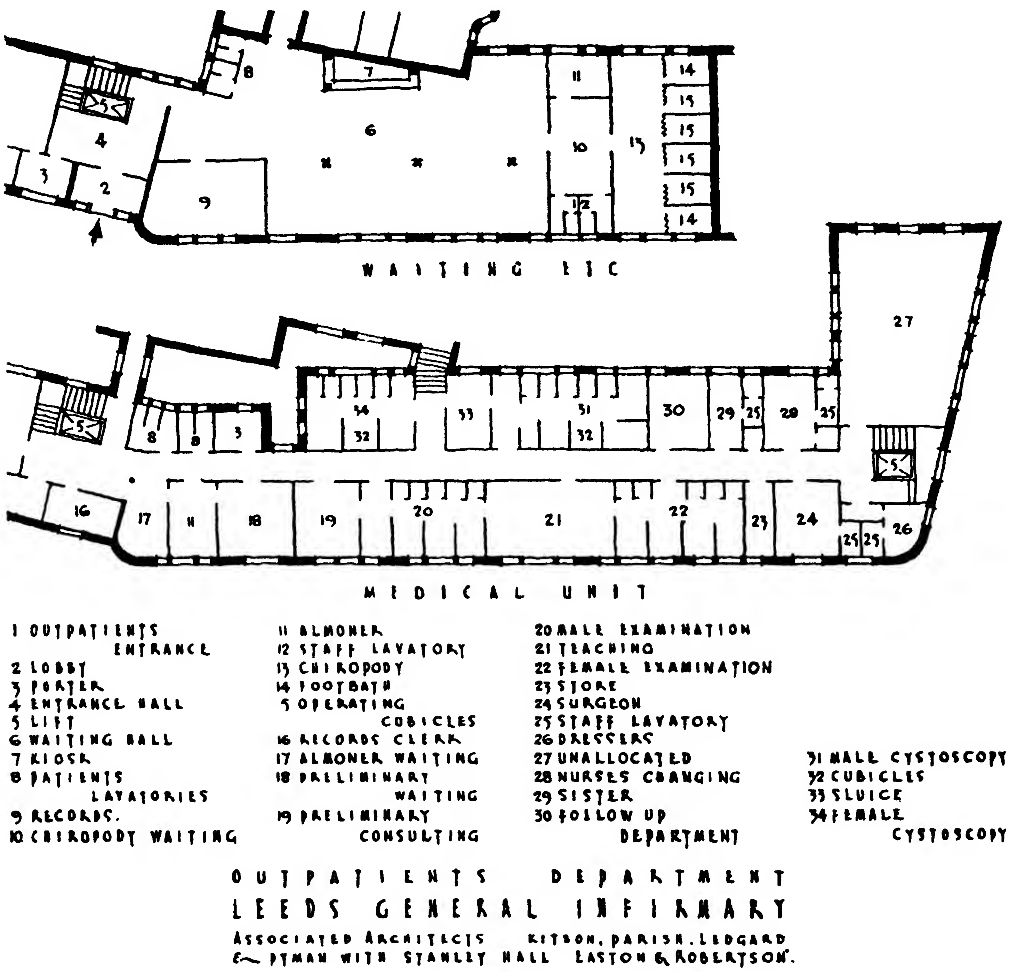


FIG. 49.

arranged after their first examination, when they are told to arrive at the appointed time and take their seats within a short distance of the consultant.

Owing to the large number of patients treated—amounting to hundreds in the course of a day—care must be taken in planning the circulation of patients so that they retrace their steps as little as possible. When the consultant has examined the patient and sent him back to dress, he does not want to see him again. Exits from the dressing cubicles

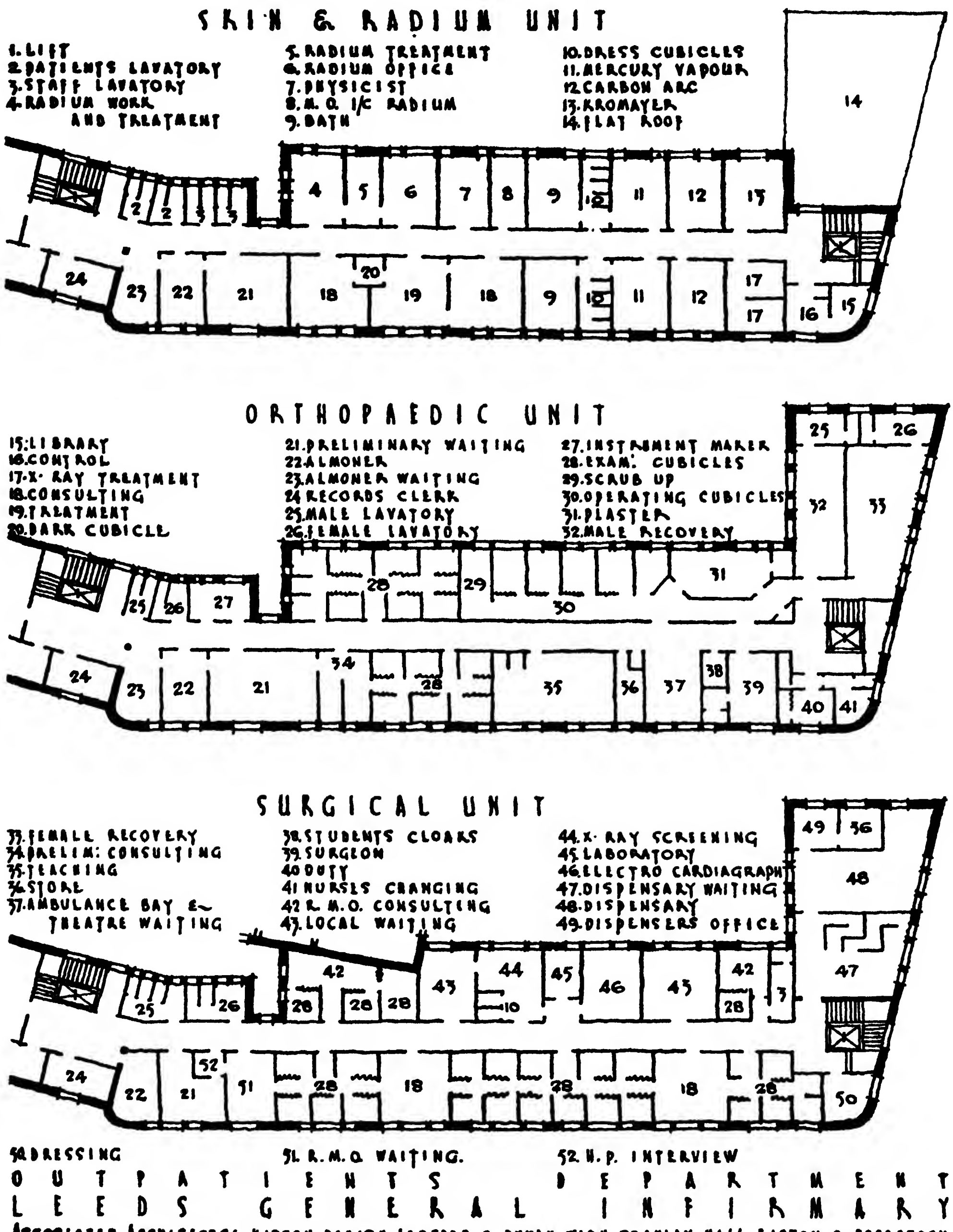

SKIN & RADIUM UNIT
1. LIFT
2. PATIENTS LAVATORY
3. STAFF LAVATORY
4. RADIUM WORK AND TREATMENT
5. RADIUM TREATMENT
6. RADIUM OFFICE
7. PHYSICIST
8. M.O. I/C RADIUM
9. BATH
10. DRESS CUBICLES
11. MERCURY VAPOUR
12. CARBON ARC
13. KROMAYER
14. FLAT ROOF
ORTHOPAEDIC UNIT
15. LIBRARY
16. CONTROL
17. X-RAY TREATMENT
18. CONSULTING
19. TREATMENT
20. DARK CUBICLE
21. PRELIMINARY WAITING
22. ALMONER
23. ALMONER WAITING
24. RECORDS CLERK
25. MALE LAVATORY
26. FEMALE LAVATORY
27. INSTRUMENT MAKER
28. EXAM: CUBICLES
29. SCRUB UP
30. OPERATING CUBICLES
31. PLASTER
32. MALE RECOVERY
SURGICAL UNIT
33. FEMALE RECOVERY
34. PRELIM: CONSULTING
35. TEACHING
36. STORE
37. AMBULANCE BAY & THEATRE WAITING
38. STUDENTS CLOAKS
39. SURGEON
40. DUTY
41. NURSES CHANGING
42. R.M.O. CONSULTING
43. LOCAL WAITING
44. X-RAY SCREENING
45. LABORATORY
46. ELECTRO CARDIAGRAPH
47. DISPENSARY WAITING
48. DISPENSARY
49. DISPENSERS OFFICE
50. DRESSING
51. R.M.O. WAITING.
52. H.P. INTERVIEW
OUTPATIENTS DEPARTMENT
LEEDS GENERAL INFIRMARY
ASSOCIATED ARCHITECTS: KITSON, PARISH, LEDGARD & PYMAN WITH STANLEY HALL, EASTON & ROBERTSON.

FIG. 50.

should be planned so that out-going patients do not cross those coming in. This idea of return corridors is, of course, expensive, and can only be justified if the work done at the hospital warrants it. Fig. 48 indicates a scheme designed on this basis and subsequently cancelled and erected on the vertical and appointment system.

When some measure of control can be established over the number of patients who will visit the department and the consultants are able to agree on a form of layout which can be used by any of the three or four distinct units, the elasticity thus obtained will be both economic and efficient and reduce a large measure of the waiting. The programme of hours is often arranged so that the different consultants can occupy the same suite of rooms at different times. It is a waste of money to build consulting-rooms

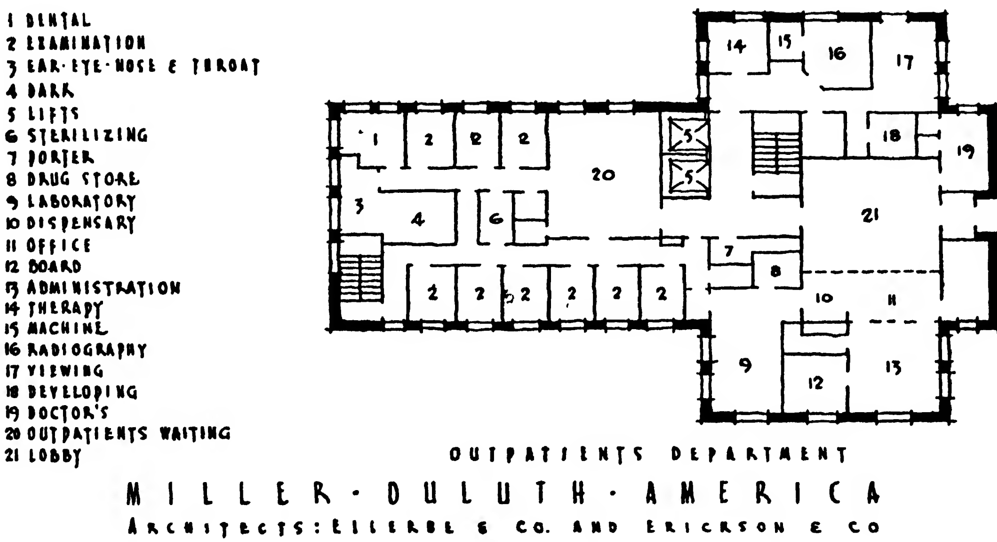


FIG. 51.

to be occupied for only a few hours each week. There are indications of control being established, with a result that waiting-halls are likely to be reduced in size, and eventually each separate consultant suite will have its own waiting space. This would be an ideal arrangement, as such rooms are less lofty and so cheaper both in capital and running costs, less time is wasted, and the risk of infection is minimised.

There is a movement to plan this department—in conjunction with the radio-diagnostic and physiotherapy departments—vertically instead of horizontally (see Figs. 49 and 50). The object of this arrangement is to save waiting and to link up in-patients and out-patients as far as possible. The out-patients are received on the ground floor and distributed to the upper floors, where they are treated on the same floor as in-patients of similar classification. By this arrangement it is possible to sectionalise the out-patients and thus save the vexatious delays of waiting. There must be adequate lift service for this purpose and the out-patients department for each floor

must be centrally placed and self-contained. Adopting this system the various units might be grouped:

a X-ray and radio-therapy;
b casualty clearing—surgeons' dressing-rooms and dispensary;
c dental; ear, nose, and throat; ophthalmic;
d physiotherapy; orthopaedic and children;
e psychiatric; gynaecological and maternity;
f medical;
g surgical.

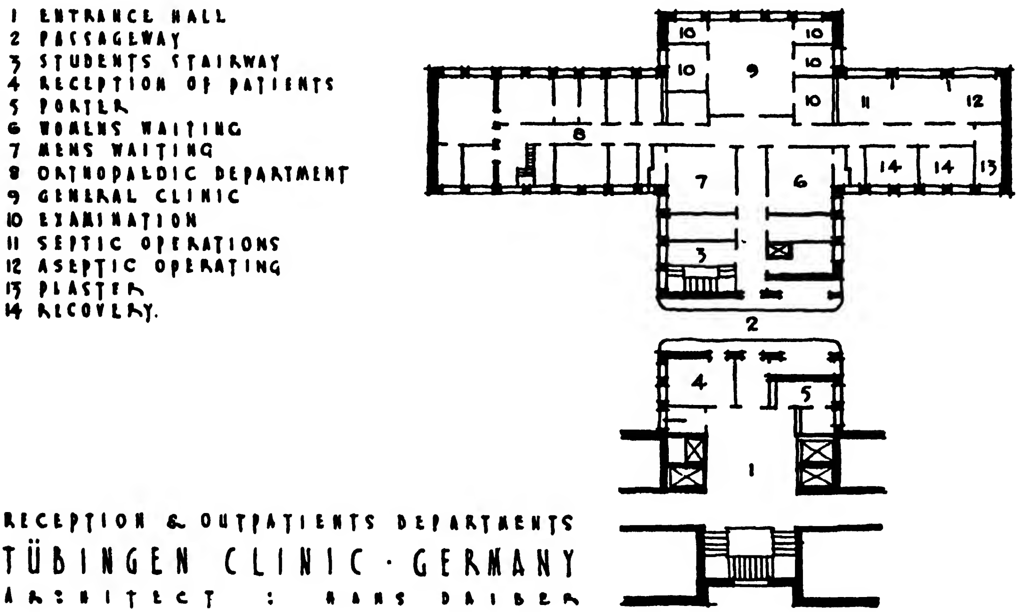


FIG. 52.

Out-patient and casualty work in the large acute general hospital has in recent years increased enormously, and the proposed accommodation in the average units may easily become inadequate during the actual building operations. It is essential, therefore, to allow for simple means of extension to all important sections of the department.

The Report states that this is a developing service in municipal hospitals, and it does not appear that the out-patient practice of local authorities has yet become sufficiently standardised to enable it to suggest any standards. The Building Centre Hospitals Committee nevertheless considered the problem and issued a schedule of requirements which is available upon application.

For further information on the principal departments, see the radio-diagnostic department (Chapter 21) and the physiotherapy department (Chapter 23).

Figs. 51 to 56 indicate further alternative layouts adopted in Europe and America.

GENERAL ACCOMMODATION

Waiting-hall. This hall is expensive to build, decorate, and heat, and the large number of patients it accommodates tends to cause noise and risk of infection. If out-patient work is limited to casualties, i.e. accidents, and to consultative work on the appointments system, large waiting-halls can be dispensed with.

Without knowing the probable number of out-patients to be accommodated, it is impossible to give any information as to the size of the hall, but it must be remembered that ample seating accommodation should be provided for the numbers which use the various units at any one time—fixed benches (with back rests) are generally used instead of chairs (see Plate XVIII).

The lady almoner should have a room where she interviews the patients and registers them. The medical cards should be filed in alphabetically labelled pigeonholes or boxes

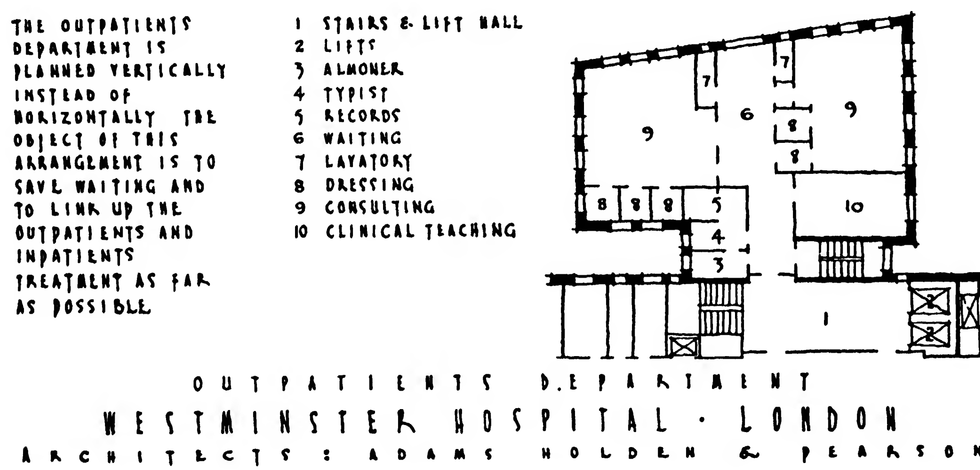


FIG. 53.

on one side of the hall. In front of these there should be a broad counter for the handling of the cards by the clerk in charge. There should be either a bell or a light signal system to indicate to the clerk when a fresh batch of patients are to be passed in to the various consultant units. Spare wall space surface should be used for notice panels.

Lavatory accommodation should open off the hall to facilitate the control of its use by the staff, and at least two basins and two closets for each sex are required. A drinking fountain is generally considered essential and a service buffet should be provided for serving tea and small snacks to waiting patients; a food store adjoining is required.

The waiting-hall should be well lighted and ventilated, and as it is usually necessary to plan the various units around the hall, it will probably have to be top-lighted, an advantage of this should be taken to extend its height to, say, 15′—that is, 5′ above that of other sections, which should be about 10′ high.

Staff-rooms. The staff-rooms, etc., should be conveniently placed away from the surgeries of the department, in order to prevent disturbing the circulation and preserve privacy. These rooms should, if possible, be provided with external access.

Lecture Theatre. Voluntary hospitals encourage patients to collect together in large numbers for an afternoon's talk and therefore a lecture theatre is required. It should be equipped with a roller cinema screen, dark blinds, projection apparatus, and a large blackboard. In small units, the waiting-hall when provided can be adapted.

Clerical and Filing. This unit concentrates the records of the patients and facilitates cross reference between the doctors' "medical" files and the clerks' "financial" files. The patients records are medical (which may, of course, include in addition special notes

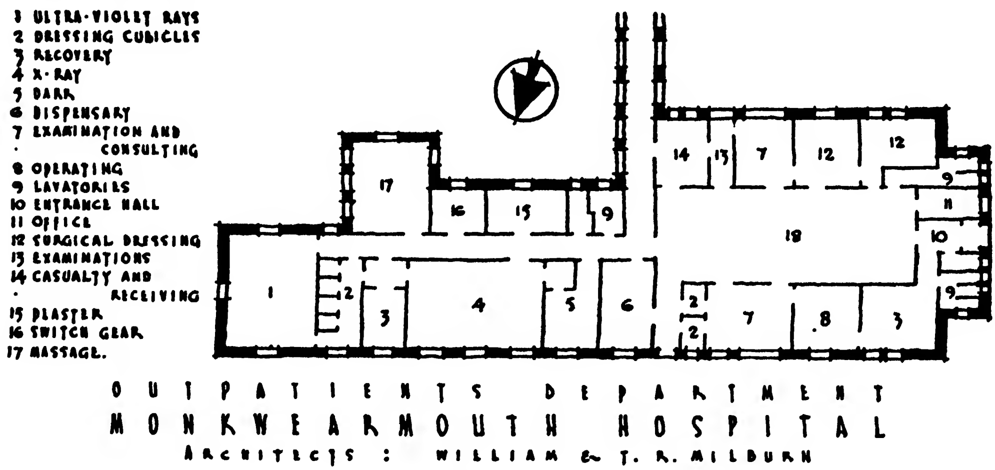


FIG. 54.

from half a dozen departments, such as radio-diagnostic, skins, etc.). The other record is only concerned with the patients contributions and possibly notes on the welfare side by the almoner.

SURGICAL UNIT

Consulting and Examination Rooms. When possible, they should be provided with a south-east aspect and the maximum of light and air. When they are on the south, heat and glare insulating glass should be provided to the windows.

Staff circulation is to be separate from that of patients, who should enter from the lobby adjoining the undressing cubicles. A through-way should be provided for patients who are not required to undress.

An area of about 200 sq. ft. each is required, and they should be provided with a lavatory basin. Substantially more space is needed in teaching than in non-teaching hospitals.

Undressing Cubicles. When required, they should be provided in sufficient numbers for

PLATE XIX. Biochemical Laboratory
Edgware General Hospital

PLATE XX. Casualty Unit
Edgware General Hospital

[*To face page 134*

PLATE XXI. Ear, Nose and Throat Unit: also Ophthalmic Unit
Edgware General Hospital

PLATE XXII. Plaster Room
Edgware General Hospital

To face page 135]

all the treatment and consulting-rooms to be in continuous use. They should be so planned that a patient, when undressed, need not enter a public corridor, but, having dressed again after examination, can find his way out without having to re-enter the examination room.

The cubicles are to be so arranged that undressed patients are separated from those dressed, while both may be adequately supervised by the nursing staff. Cross-ventilation is required. From the cubicles, the patients enter directly into a lobby, where a nurse can take weights, temperatures, etc., and can direct them to the examination room.

There must be sanitary accommodation near at hand for the patients and provision for taking and examining specimens of urine. It is useful—if it can be planned—to place a hatchway between the patients' W.C. and the room or recess in which specimens are examined.

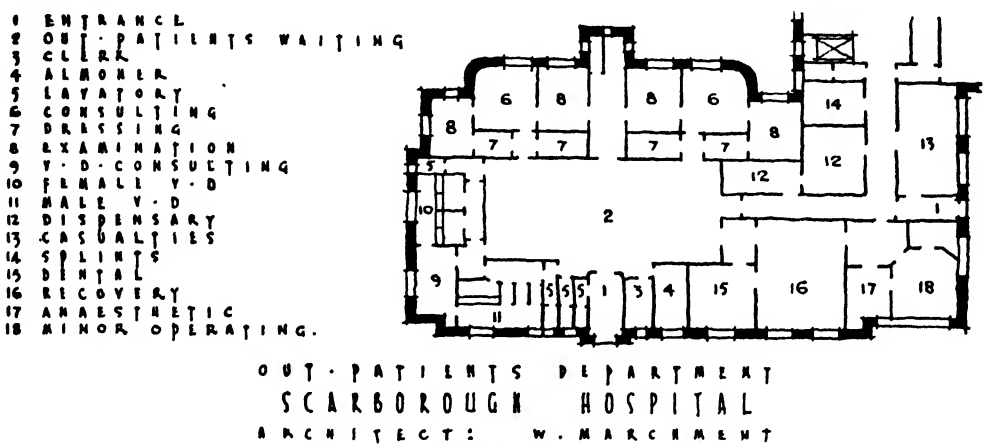


FIG. 55.

Minor Ailments. When provided, the entrance, waiting-room, and record office should adjoin. The treatment room should contain collapsible curtain-type cubicles, with bathrooms adjoining. The doctor's room should communicate with the treatment room and with the corridor.

VENEREAL DISEASE UNIT

This unit—although it should be provided with its own entrance—is part of the out-patients department.

The main waiting-hall is sometimes used by the venereal disease patients, but it is more usual to provide small waiting-rooms for each sex. If the unit is only a small one, the sexes can be treated on separate days (or hours), when one waiting-room will suffice.

The principal accommodation required, in addition to the waiting-room, is:

- *a* office
- *b* examination room
- *c* treatment room
- *d* irrigation room
- *e* small rest room
- *f* toilet facilities.

The layout should be planned so that patients pass direct from examination room to treatment or irrigation room, and thus leave the unit without again passing through the waiting-room.

The rest-room should be planned close to the treatment and irrigation rooms. In some units a special room is required for urethroscopic work and a laboratory for tests and culture work, provided with a small dispensary adjoining.

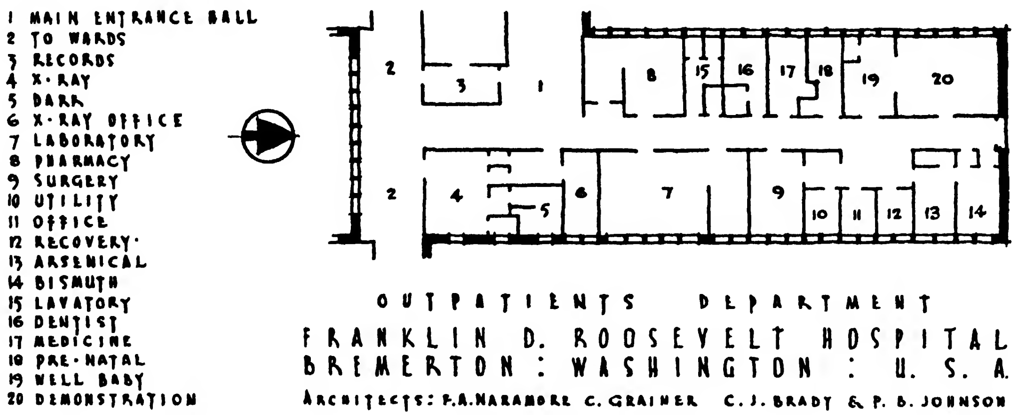


FIG. 56.

When the V.D. unit is attached to a general hospital, wards for in-patients of both sexes should be provided in the hospital.

Office. The office is placed off the waiting-room and should be provided with its own toilet. In one corner of the office, weighing apparatus should be installed in order that the nurse can watch the weight of patients. A small linen cupboard is required.

Examination Room. The examination or consulting-room, should have an area of about 180 sq. ft. (15′ by 12′) and be equipped with lavatory basin and sink. Attached to this room will be at least two small dressing cubicles, about 8′ by 6′, each having a small urinal basin.

If possible, exit from the examination room should be direct from the dressing cubicles, and not back through the examination room.

Treatment Room. This should be close to the examination room, and have an area of about 170 sq. ft. (14′ by 12′). On one wall should be placed sinks and a lavatory basin, and provision should be made for bottle shelving.

Penicillin treatment requires accommodation to be provided for patients who are there all day, receiving injections every few hours and resting in between.

Near the treatment rooms, a store for dressings and drugs is required.

Irrigation Room. Again, this room should be near to the examination room. It should be oblong in shape, at least 15′ wide, the length being determined by the number of irrigation stalls provided, with sufficient circulation space around them. The room is arranged with the stalls in the centre and space behind for the doctors to pass up and down to give instructions.

The stall divisions may be either terrazzo or fireclay slabs, usually 5′ 6″ high, 2′ 6″ to 3′ deep, and spaced at 3′ centres. A continuous fireclay trough is placed 2′ 4″ above the floor along the back of the stall divisions, a 9″ trough to discharge into the floor channel is placed immediately under and directly connected to soil drain; curtains are placed at the back of the stalls for privacy. Metal-covered tables or trolleys are used for women.

One or two sitz baths or bidets should be placed against the side walls, together with a sink and a lavatory basin and a few sets of irrigation apparatus.

The walls should be in terrazzo or tile to a height of at least 5′ 6″ and should be continuous with the floor finish. Terrazzo or tile is the most satisfactory flooring, as asphalt does not provide an even surface, lead is too soft, and concrete too porous; all floors must be graded to a channel of fireclay or similar.

GYNAECOLOGICAL UNIT

The out-patients department should be planned for the patients to visit the gynaecological unit without going through the general waiting-hall. It should form a separate unit and be sub-divided from the rest of the maternity department, although it may be directly in communication with it.

When possible, every endeavour should be made to plan this unit adjacent to a small secluded garden where out-patients can wait during hot weather or on sultry days.

Accommodation similar to that provided for a normal surgical out-patient unit will suffice.

An operating unit may be required for gynaecological use only. It requires space from which operations can be viewed by pupil midwives. Whether it is incorporated in the out-patients department or maternity department proper is a matter for local decision.

MATERNITY UNIT

Ante-natal. Ante-natal supervision has become a necessary part of the work of the maternity department. It involves the provision of:

- *a* an ante-natal clinic for the routine supervision and instruction for pregnant women and for obstetric consultation;
- *b* wards in the maternity department for patients needing special examination or treatment.

The planning of the unit will depend on the number of women likely to attend each session, and thus on the number of beds in the maternity department; on the existence or not of an external midwifery service; and on the number of sessions to be held per week. It may form a separate part of a general out-patients department or, preferably, be a part of the maternity department itself, when it may be combined with the reception unit, though having a separate entrance. The growing importance of the ante-natal unit should be kept in mind, and ample space should be allowed for its development. The accommodation may consist of:

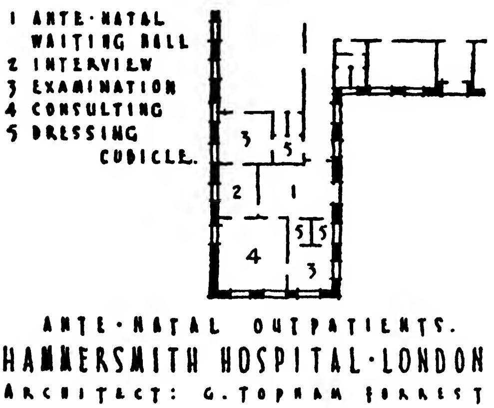


FIG. 57.

a separate entrance from that used by ordinary out-patients;
b waiting-room and almoner's office;
c interview room where the nurse can see the patients one at a time and take particulars of the case and for use as a record-room;
d consulting-rooms with examination cubicles (the number varying according to the number of medical officers likely to be holding sessions), and a sufficiency of dressing cubicles;
e private compartment for taking urine specimens;
f urine testing-room;
g lavatory and W.C.;
h doctor's room;
i small dispensary may also be needed.

Patients are admitted via the interview room and the case of new patients taken. The almoner's office adjoins the interview room with access for patients from the latter or separately from the corridor before leaving after examination.

The waiting-room is placed near the entrance and divided in order that the friends of patients may wait apart for their return after examination and treatment. This waiting-hall should be fitted with settees suitable for pregnant women and provided with separate toilet facilities. The doctor's room is provided with a private lavatory, and should be planned adjacent to the waiting-hall and examination rooms.

The examination room is equipped with dressing cubicles behind the examination cubicles to allow the nursing staff to prepare patients for examination without loss of time. The interview room requires at least two blackboards and glazed display cases, and a small urine testing-room, adjacent to the examination room, should be provided.

The Report recommends the various rooms should be approximately the following sizes:

a waiting-room—not less than 500 sq. ft.; in a busy clinic where several doctors work simultaneously a larger room may be necessary;

b history and record-room—150 sq. ft.;
c consultation-room—100 sq. ft.;
d examination cubicle—60 sq. ft.;
e dressing cubicle—20 sq. ft.

See also Chapter 27 and Figs. 136 and 137.

Post-natal. A separate post-natal section is quite unnecessary. Those patients who attend have separate sessions in the ante-natal unit.

District Nurses. Rooms for the preparation of equipment, etc., are required by nurses on district duty.

Consideration must be given to these nurses when planning the nurses' home, as some bedrooms may be required for them.

Lecture-room. This is required in large hospitals, for the instruction of the medical students and midwifery nurses; auxiliary-rooms for lecturers, waiting patients, and for students are also required in conjunction therewith.

DENTAL UNIT

A short connection lobby is required between the waiting-room and surgery, this acts as a "sound buffer"—the reception-room will suffice. Immediately adjoining the surgery is the recovery room, and planned thus allows patients, after receiving treatment, to leave the unit without passing through the waiting-room.

Waiting-room. The size of this will depend on whether out-patients are received in addition to the hospital patients. If the latter only are treated, a quite small room contiguous to the surgery will suffice. A room 16′ by 12′ will provide sufficient accommodation for eighteen patients.

Reception-room. This should adjoin the waiting-room so that patients pass direct from one to the other. The reception-room contains the desk for sister-in-charge, and the usual filing arrangements, together with provision for towels.

Surgery. This is the room in which all extractions and fillings are performed. It should be a light (preferably facing north or north-east), airy room, suitably heated; good artificial light should be provided for operating on dark days.

The size of room should be at least 12′ by 10′. This area is sufficient if a single chair is provided, but at least 100 sq. ft. per chair must be added for further chairs. It is preferably lit by an operation theatre type window with adjustable blinds, in order to control the lighting as desired.

The equipment consists of a pump chair with a special attachment for children, a fountain spittoon with saliva ejector is needed for each chair, as well as the usual hot and cold water, air and electrical supplies, a dental cabinet for instruments, a modified Walton apparatus for nitrous oxide anaesthesia, and a couch for emergency purposes.

Recovery Room. This room should be so planned that patients leaving or entering it are not brought into contact with those in the waiting-room. The room may be sub-divided where adult patients of both sexes are being treated. The size will depend on the number of out-patients and/or anaesthetic cases likely to be dealt with by each dentist.

It should be provided with chairs and a couch, lavatory basin, sink or spittoon, with hot and cold water laid on. A bubbling fountain at which patients can apply their mouths direct to the water, so obviating the use of mugs, is desirable.

Dental Laboratory. An oblong room is required (say 24′ by 12′) provided with sinks, cupboards, a bench for mechanics, with special benches with tool drawers for plaster work, etc. In large units other rooms may be necessary, one for polishing and plaster work and another for vulcanising and casting.

Adjoining the laboratory, a fume cupboard (8′ by 6′) with a sink and vulcanisers on a bench is required. A small compressor plant to supply the mechanics' bench and each surgery is also necessary.

OPHTHALMIC UNIT

This unit should be, for preference, on the ground floor, and it must be ensured that the floor is smooth but not slippery and that there are no mats on which blind people might stumble. Access will be from the waiting-hall and exit so planned that it is unnecessary for the patient to re-enter the waiting-hall. See Fig. 58.

It is probable that the numbers using this unit in a small out-patients department will not warrant the provision of separate examination cubicles, a requirement that sometimes has to be met in large eye units. A small unit, which is also often used for the examination of throat cases, will comprise:

- *a* examination or testing-room. This should be at least 25′ in length and not less than half as wide, and must be capable of being darkened.
- *b* dark-room. Unless a general hospital specialises in eye work a small single cubicle dark-room for retinoscopy, etc., will suffice.

A large ophthalmic department should be planned to be easily accessible from the street, and will consist of:

- *a* waiting-room;
- *b* testing-room;
- *c* dark-room;
- *d* perimeter or a slit-lamp dark-room;
- *e* optician's room;
- *f* surgery;
- *g* rest-room.

Waiting-room. If space must be economised, a special waiting-room need not be provided if the unit adjoins the general waiting-hall, in which case a few patients may be admitted to wait in a slightly enlarged testing-room.

Testing-room. As previously stated above it should not be less than 25′ long. If there are to be a great many patients and several surgeons, clinical assistants or students at work, the room must be correspondingly wider, about 15′ width being allowed for each surgeon.

It is important that the test types are excellently illuminated, the best form of illumination being that of pendent lights on rigid arms with shields. The test card must be evenly illuminated and there must be no light in any direction from these bracket burners. The lights on the test types should be controlled from a switch-board near the

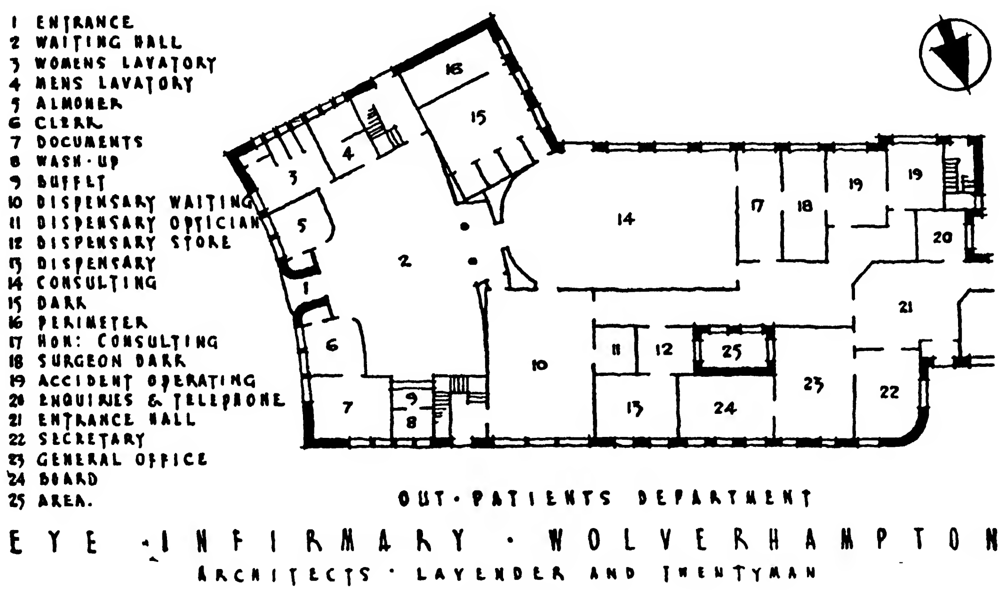


FIG. 58.

surgeon's table. The general lighting of the testing-room should be good daylight as far as possible, and electric light when daylight fails. There should be one "daylight" electric light near or over the surgeon's table available for examination. Also a spot light for use with the Maddox rod, probably best placed in the test type if a blind is fitted to the window near it.

A wash basin should be fixed close to the surgeon's desk.

Dark-room. One room for every surgeon or clinical assistant is required, opening off the testing-room for fundus examination and retinoscopy. This room must be light proof and yet well ventilated, and consist of two cubicles each measuring 3′ 6″ by 6′, the dividing partitions between the two projecting to 4′.

An adjustable bracket for the retinoscopy lamp and a small shelf on which the surgeon may place his instruments are required.

Perimeter Dark-room. This and possibly a slit-lamp dark-room are practically an essential part of the unit. This dark-room should be larger than the dark-room for retinoscopy. Good central light is required and a plug for each instrument.

Optician's Room. A small room is necessary if an optician attends for fitting of glasses and necessary adjustments. Good light (daylight and artificial) is required.

Surgery. This is for minor surgical operations and attention to external eye diseases. In this room a nurse should be in attendance for irrigation of eyes and treatment of minor ailments.

Equipment required is a surgeon's table for minor operations, a chair with head rest like a dentist's chair, one or two glass-topped tables, i.e. all the necessary equipment of a casualty operating theatre.

Good daylight and general electric lighting are necessary and brackets for adjustable lamps.

Rest-room. If space permits, a rest-room with a couch might be provided.

ORTHOPAEDIC UNIT

A small unit, if required, would be planned adjoining the accommodation provided for radio-diagnostic investigation, but usually the orthopaedic surgeon will use one of the general suites of examination and consulting-rooms in the surgical unit.

EAR, NOSE, AND THROAT UNIT

In a hospital making special provision for these cases, separate accommodation for this purpose is necessary, otherwise the examination or testing-room of the ophthalmic unit will suffice.

FINISHINGS

Waiting-rooms, changing cubicles, examination rooms of various kinds, clinical rooms, etc.; here a very easily cleaned surface for the walls, i.e. plaster, painted with or without a tile or terrazzo dado, is needed, with plaster ceilings and every convenience for the avoidance of dust, etc. For the floor of the waiting-rooms and corridors a material such as tile or terrazzo is called for, or as an alternative rubber or linoleum laid between terrazzo coved skirtings. For the waiting-hall a 4′ 6″ cork dado with sound-absorbent wall-boards above is effective.

For venereal disease clinics the same general principle will apply with a fairly general application of glazed tiling or terrazzo where the use of special sanitary fittings is involved. Reference to this unit has already been made in regard to the irrigation room.

For minor operation rooms, including dentistry, the treatment of finishings generally would be as for an operating department.

Partitions surrounding treatment and casualty rooms should be constructed in two thicknesses, with an intervening sound-proofing space filled with non-conducting material.

16

The Laboratories

IT IS REALISED that much depends in therapaeutic practice upon the extent to which pathological facilities are placed at the disposal of the pathologists and technicians as an aid to diagnosis and treatment. It is therefore essential that in every general hospital dealing with the acute sick a small laboratory staffed by at least one trained laboratory assistant, in which the routine pathological work of the hospital can be carried out, should be provided.

Owing to the difference in practice and the varying requirements of different hospitals, The Report did not recommend standards for this department.

HOSPITAL LABORATORY

In the past, with few exceptions, laboratories have only consisted of a room or rooms set aside in a new building which, while employing new methods of construction, perpetuated, from the laboratory technicians point of view, many anachronisms. These included inadequacies of day-lighting and of artificial illumination, insufficient ventilation, and inflexible and inaccessible services.

A laboratory for routine investigations or for research should be flexible in design yet pleasant to work in with uninterrupted access to all facilities. It is run by the pathologist and the biochemist, with special trained staff who are generally called laboratory technicians.

PLANNING

Laboratories with top lighting or lit from north light roofs, give inadequate lighting without heavy maintenance charges to keep the glass clean internally and externally, and further give a depressing atmosphere in which to work. Rooms with both east and west lighting are more satisfactory, and the psychological benefits to the pathologists and technicians and more agreeable working conditions are of no small importance. The main window of the laboratory should face east to obtain the best light, and it is always free from the glare and heat of direct sunlight.

It should be planned so as to be convenient to the out-patient department. But since a small proportion of patients themselves must go to the laboratory there is less need for its convenience to patient traffic, in-patient or out-patient.

The minimum space required for a small hospital (one hundred beds or less) will usually be about 200 sq. ft. of floor area. As the size of the hospital is increased not only

the size but the proficiency of the laboratory staff may be expected to increase and the functions gradually separated into specialised sections—chemical, bacteriological, tissue, and serological. Although there will be some biochemistry, the bulk of the work will be bacteriological, histological, and haematological. Thus the space required for the laboratory proper may reach as much as 600 sq. ft. in hospitals of two hundred beds or to 1,000 sq. ft. in a hospital of five hundred beds. This is for routine work only and does not include space for any research work it is desired to undertake.

The entire laboratory area should be planned in detail, including the placement of equipment, by the pathologist in consultation with the administrator and the architect, before construction begins. The laboratory requires a generous supply of plumbing, water, gas, and electrical outlets and vent hoods and it is only by careful advance planning that their proper position and adequacy can be assured.

ACCOMMODATION

Laboratory. The benches should be arranged on a unit spacing (see Fig. 59), with the shelf storage place between the benches, partly to give a measure of seclusion, partly to avoid working back to back (which is liable to cause collisions and may be dangerous when fragile apparatus containing acids is in use), and partly to avoid dark and inconvenient storage.

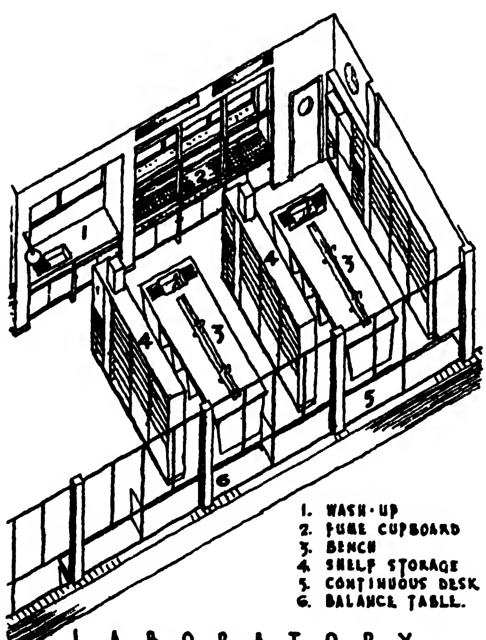


FIG. 59.

The unit benches with sinks should be open structures, with shaped top galvanised-iron rubbish bins suspended clear of the floor; no materials or loose equipment should be stored beneath the benches. This avoids the usual dark and dirty corners, does away with the necessity for stooping on the part of the technicians, renders the services accessible, and leaves a clear floor on which "spills" can quickly be mopped up.

The benches require teak tops with teak dashboards which are removable for access to all service pipes. The controls to services are set in the bench apron and are distinguished by both colour and shape. The taps, like those to the fume cupboards, are similarly recessed beneath the projecting front edges; they operate by means of long rods running across to the valves at the back. Shallow horizontal ducts provided with removable covers set in the laboratory floor passing under the benches, carry all services to each bench.

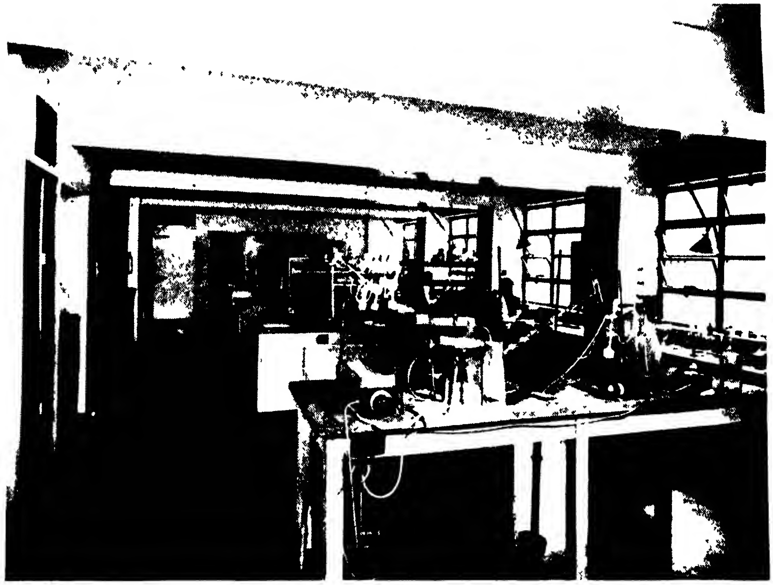


PLATE XXIII. Laboratory
Great Ormond Street Hospital for Children, London

PLATE XXIV. Biochemical Laboratory
Hospital Centre, Birmingham

[*To face page* 144

PLATE XXV. Museum
Great Ormond Street Hospital for Children, London

PLATE XXVI. Pathological Laboratory
Central Middlesex Hospital

To face page 145]

All materials should be stored on painted wooden shelving placed between the benches, and apparatus in sliding-fronted cupboards, which should include a low-temperature drying cupboard for vessels.

Continuous desk space is required under the east window, for writing up notes, etc. All doors should be hung to open outwards for means of escape in case of fire.

Near the laboratory should be a shower, operated by a quickly operated lever handle, so that any person splashed with acid can get quickly beneath it.

Fig. 60 is a typical layout for a small laboratory.

Wash-up Room. This need only be a small room adjacent to the laboratory, in which steam steriliser, autoclave, copper for boiling up dirty test-tubes, etc., can be placed.

Fume Cupboard. This is required for work where noxious fumes prevail. For a small laboratory, a central flue is sufficient, the various compartments of the cupboard being divided off for different experiments, and the fumes drawn from the top of each compartment by a fan and discharged at roof level. The dividing partition can be of armourplate glass.

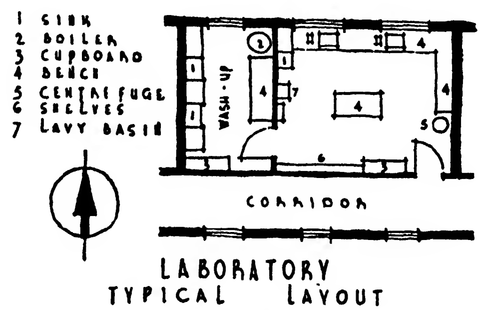


FIG. 60.

In large laboratories, a series of fume cupboards should be provided and all should be designed with easy access to service pipes. They should be provided with armourplate glass or wired glass sliding sashes, the access to be from the laboratory side. Inside the cupboards are the fume ducts, the heavy gas duct at a low level in teak, while the light gas duct (in asbestos) runs overhead. The taps and other controls of the services to these fume cupboards should face the east windows of the laboratory and therefore be at the front. This avoids the necessity for pathologists to lean over fragile "fit-ups" to get at the taps. These should be placed in a recessed row so as to avoid accidental interference, the taps of each should be a distinct colour and shape so that they are easily distinguishable.

Balance Room. A separate balance room for delicate weighing apparatus is necessary where a great deal of biochemistry or experimental work is done. Complete insulation from vibration can be obtained by placing the instruments on tables detached from the walls, and consisting of heavy plate tops on heavy pre-cast concrete stands, insulated by two separate layers of ½" lead.

Ventilation. There must be two systems of ventilation, one for the laboratory and the other for the fume cupboards, and therefore it is suggested that all laboratories of any size be air-conditioned. Eleven changes of air per hour will entirely abolish the hitherto typical hot and fume-laden atmosphere. A duct delivers the conditioned air at the

laboratory ceiling level and extracts it at floor level. The fume cupboards have high- and low-level extracts for light and heavy gases respectively. The high rate of air change will reduce condensation—a trouble common in laboratories—to a minimum.

FINISHINGS

The floors should be of a resilient and stain resistant material. Usually they are of wood boards or cork tiles set in mastic and divided by rubber strips, except to wash-up room, where terrazzo or similar should be used.

In laboratories, traditional lighting consists of a globe suspended from the ceiling or an ordinary disc reflector likewise hung. When placed over the tables, the source of light is generally within sight of the technician, causing both eyestrain and discomfort from heat. The following requisites are assumed for proper laboratory lighting:

a maximum intensity of illumination on the working plane;
b avoidance of disturbing shadows;
c the source of light out of sight of the technicians;
d maximum foot-candles per watt, which in turn implies a minimum of heat generated.

The walls to be finished with washable paint or tiles. The paint used must have special acid and steam-resisting properties.

PATHOLOGICAL LABORATORY

This department is most convenient if situated in the administration department. The size of the laboratory and equipment will depend on whether the hospital laboratory is self-sufficient or whether it is to deal only with certain classes of work while others are sent to a central laboratory working for a number of hospitals. For a normal-sized hospital a laboratory having a floor area of 300 sq. ft. is usually adequate.

GROUP LABORATORY

In a small hospital the personnel available will usually be capable of doing little more than the simpler routine procedures—chemical and microscopic examination of urine and stools, blood counts, blood chemistry, examination of smears, and possibly chemical examination of gastric contents—therefore the London County Council (see Fig. 61) have established group laboratories to serve their hospitals, in addition to a histological laboratory. The object of these group laboratories is to supplement the work of the hospital laboratories in regard to more specialised pathological requirements which necessitate an advanced technique and more complicated apparatus and experienced pathologists.

Some of the large voluntary hospitals also provide through central and extremely well staffed and equipped laboratories facilities for doing the unusual work and work

demanding an exceptionally high degree of technique from other hospitals in the district.

In a teaching hospital a large laboratory suite is desirable, and this will be equivalent to a group laboratory. The accommodation normally provided is:

- *a* pathologist's office
- *b* pathologist's laboratory
- *c* general bacteriological laboratory
- *d* general biochemical laboratory
- *e* general histological laboratory
- *f* office and record-room
- *g* media preparation room
- *h* sterilisation-room
- *i* centrifuge-room
- *j* hot and cold rooms
- *k* animal house
- *l* store-rooms
- *m* waiting-room
- *n* lavatory accommodation for male and female staff
- *o* if teaching is undertaken, a small lecture theatre and class-room laboratory for practical work will be necessary
- *p* assistant pathologists, another room should be added for each.

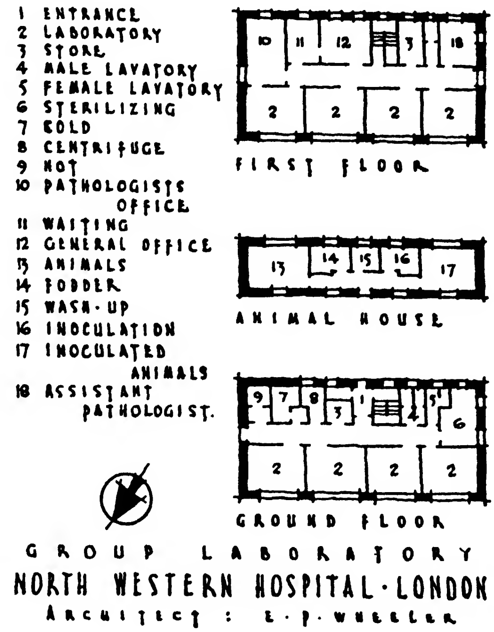


FIG. 61.

This accommodation can be reduced by combining the pathologist's office with laboratory; general bacteriological with histological laboratory; and media preparation with sterilisation-room.

In planning, the animal house should be preferably outside the laboratory and can usually be planned to be reached from an external open gallery which is cut off from the main unit by a lobby and two sets of doors. The pathologist laboratory, general bacteriological laboratory, general biochemical laboratory, office and record room and media room should have a northern outlook, but it is not absolutely essential for the latter. In order to provide good lighting, it is usual to provide clear glass windows as large as possible along the whole north side. The windows to be 2′ 7″ from the floor. Fig. 62 shows plans of a typical institute.

ACCOMMODATION

Biochemistry. This will embody four distinct units, namely, organic chemistry, medical chemistry, physical chemistry and inorganic chemistry. The main feature in planning

this department is to see that each unit is complete in itself but easily accessible from any other unit. The requirements are:

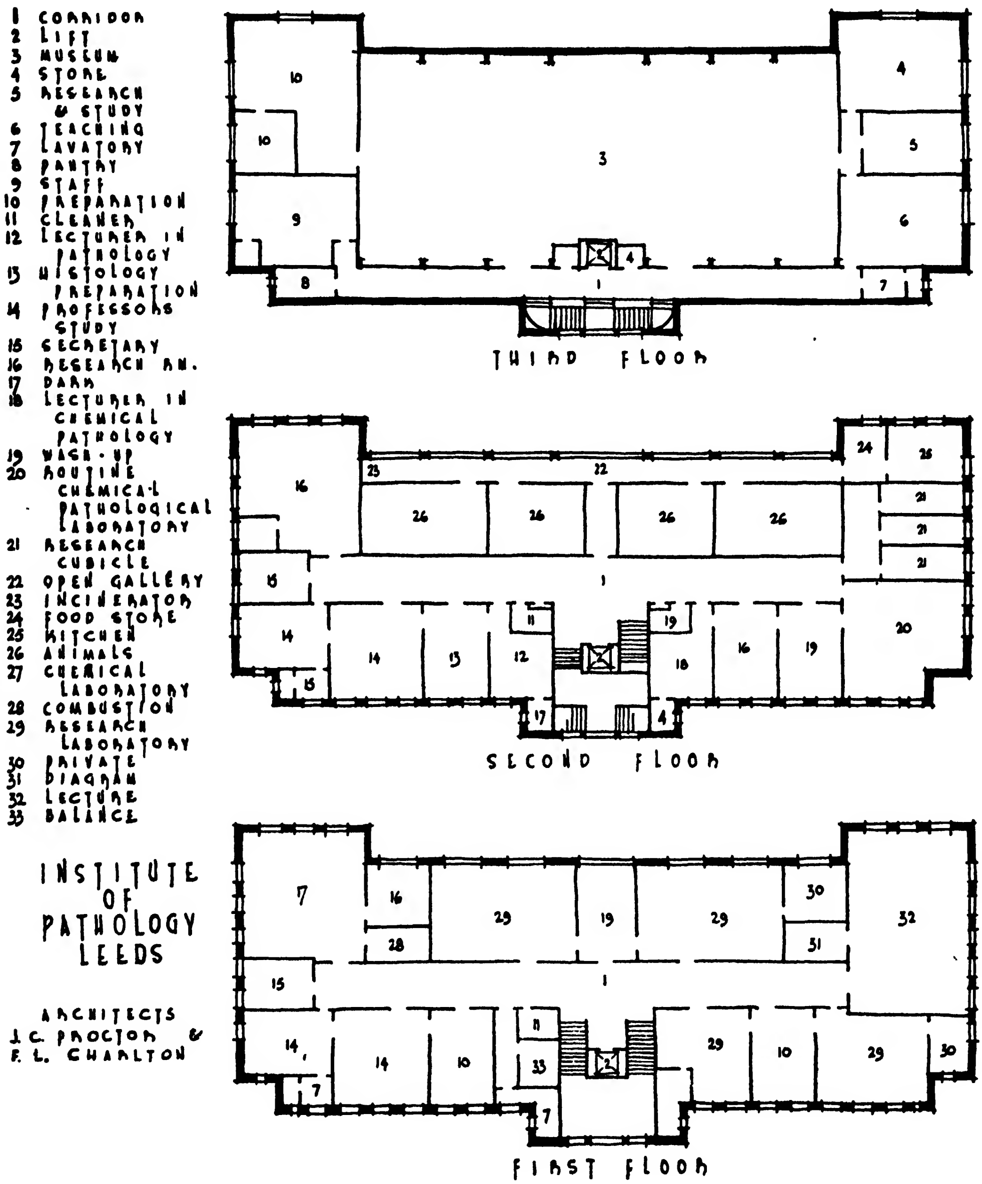


FIG. 62.

a organic and inorganic chemistry: large general laboratories, balance rooms, and combustion room, lecture theatre with preparation room and museum, stores;

b medical chemistry: large general laboratory and special laboratories, and balance rooms; special laboratories will have professors' rooms adjoining, together with lecture theatre fitted with cinematograph apparatus;
c physical chemistry: large general laboratory and special laboratories, research rooms, lecture theatre, preparation room, and mechanics' workshop and store.

Anatomy. This consists of a large dissecting room to which are attached specimen and body stores, embalming room and refrigerator plant, an X-ray unit, a unit of embryology and histology, a unit of comparative anatomy, an animal unit, and a lecture theatre. In place of some benches in the lecture theatre, seats should be provided; they can be quite simple, of tubular steel and rubber cushioning upholstered in fabric. The animal unit will always be approached from an external open gallery or an open internal courtyard, and will consist of animal rooms, a kitchen, food storage, and incinerator.

Dietetics. The equipment of the laboratory varies to the extent that in addition to tables with sinks, tables with cooking ranges are required, also refrigerators and cooking utensil cupboards.

Equipment. The majority of laboratory windows should be fitted with light-proof blinds so that the rooms can be converted into a dark room.

The equipment should be well worked out. In the principal units each assistant is provided with teak-topped benches with cupboards and drawers under, and containing sinks and points for gas, electricity, and hot and cold water, other equipment needed is: incubators, centrifuge, specimen cupboards (ventilated by the outside air), lavatory basins, and cupboards for apparatus.

Services. Those necessary in these units will include:

a gas;
b water (hot and cold), the latter with connection to the main supply for sufficient pressure to use filter pumps;
c compressed air;
d steam is highly desirable (but not essential) for sterilising-room, with a pressure of 15 lb.;
e electricity (A.C., D.C., and low-voltage);
f domestic supply, preferably from calorifiers;
g central heating should be by hot water or steam radiators, and not by fires, as the temperature should be kept more or less constant day and night.

With alternating current it is not desirable to have constant-temperature apparatus (e.g. incubators, water bath, etc.), worked by electricity; gas should be used in all these cases. All gas apparatus in which the light burns continuously must be connected to the gas supply by rigid tubing and not by rubber or flexible metallic tubing.

17
The Dispensary

THIS IS OFTEN referred to as the pharmacy department. In some hospitals this department is of considerable extent and provision is made for some degree of manufacture. Like almost every other part of a hospital, it is impossible to lay down rigid rules for the dispensary, which must be of a size, design, and complexity that suit the work of the hospital which it serves.

The Building Centre Hospitals Committee include a dispensary in their schedule of requirements for a two-hundred bed hospital. They stated that, in addition to the main dispensary, the following ancillary accommodation is required:

a distillation and sterilising-room
b store-room (including spirit store)
c dispenser's room with toilet facilities.

PLANNING

There is a difference of opinion as to whether the dispensary should be in the administration department or in the out-patients department. Suffice it to say, it should be so situated as to be convenient for distribution both to the wards and to the out-patients department.

The size of the department is again dependent on the possible daily number of patients, and in large hospitals a small waiting-hall should be attached. In a hospital with about four hundred beds, a floor area of at least 400 sq. ft. will be needed, with an addition of about 500 sq. ft. for the drug and dressing stores.

Out-patients are served through hatches over a counter in a special waiting-hall, but as the dispensary is also used for in-patients, whose supplies are taken to the wards by nurses or porters, a special window is necessary to prevent them entering the dispensary.

Fig. 63 illustrates a typical layout, while Figs. 64 and 65 are typical examples.

ACCOMMODATION

Stores. The drug and dressing stores should be near the dispensary. Convenience of access for the delivery of bulk supplies is desirable:

a for storing dressings, instruments, sundries, etc., an area of 400 sq. ft.; this room should be fitted with racks, etc., for dressings which have been taken out of the

bales and used for the issuing of dressings and sundries to wards on "dressing days," and therefore requires sufficient free floor space for porters to bring baskets and trolleys inside;

b for bales and bottles, an area of 250 sq. ft.: this room is needed in addition to (*a*) for the storage of unopened bales of dressings; one side fitted with rack for storing bottles, ointment jars, etc., and in addition it should contain a large counter for receiving goods;

c for splints, an area of 100 sq. ft.: this should be part of the dispensary with separate access; racks 6′ wide are required for storing splints of different sizes;

d for empties, an area of 200 sq. ft.: if medicines are supplied to out-patients, then additional storage is required for empty medicine bottles;

e for ether and spirit in a detached building of fireproof construction; concrete shelving 1′ 6″ wide is required;

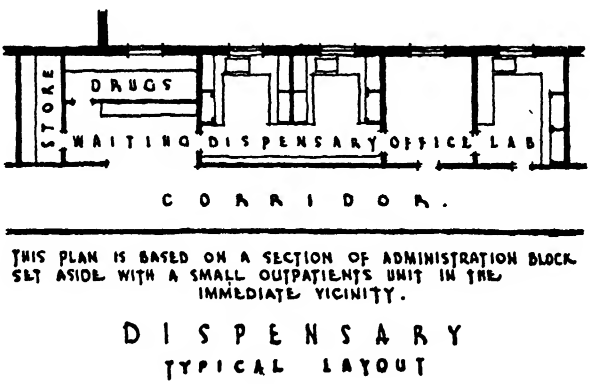


FIG. 63.

f cold storage space is also required to take all the biological products, e.g. insulin, winchesters of extract of liver, sera, pituitaries, ergot, etc.; the minimum space required is 10 cu. ft.;

g oxygen and gas should be in the dispensary or immediately adjacent, with provision for storage of empty cylinders; there should also be an emergency cupboard for gas and oxygen cylinders outside the dispensary, say, in the corridor.

Office. A small office for bookkeeping and records is useful. An area of 110 sq. ft. should suffice.

Dispensary. This should consist of three separate sections to be used for washing, general dispensary, and aseptic dispensary respectively. The minimum dimensions to be 15′ by 10′ and 25′ by 15′ respectively, the last named being as near to the given dimension as practicable. Access to the dispensary to be through the washing-room with inner communicating doors only to the other rooms.

The washing-room should be equipped with sink and draining board, and drying racks for bottles and shelving. The dispensary should be fitted—if possible—with north or east side light in the manner of a laboratory, with shelves and cupboards round the walls and a bench for mixing medicines, balances, and other apparatus, with at least two sinks provided under the windows. Shelves should not be more than 7′ from the floor and hatches to the waiting space should be 1′ 6″ wide. The aseptic room should have a completely closing window, a close-fitting door, and an air-intake fan; in all other respects it should be sealed off as completely as possible from the outside atmosphere.

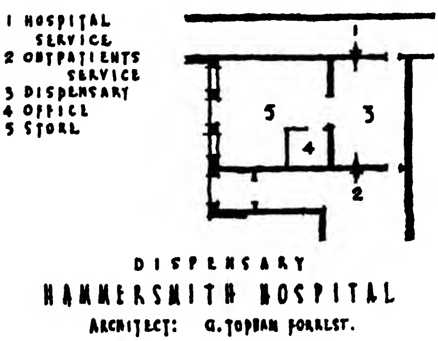


FIG. 64.

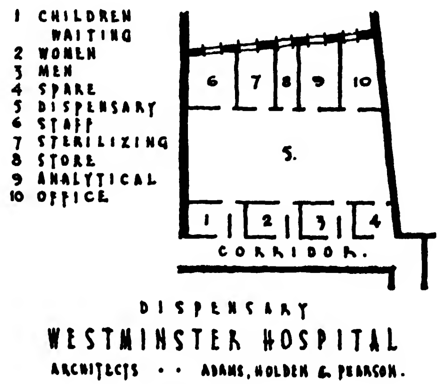


FIG. 65.

It should be equipped with a wooden bench, adjacent to sink and a concrete top bench with a glass fronted cupboard; the sink to be fitted with a three-way water valve so that a still and filter pump can be used simultaneously.

Laboratory. This is used for making stock preparations such as lotions, eusol, tablets, galenicals, sterile solutions, etc. A water still, steam steriliser, and cupboard with steam pans can be incorporated in an area of 400 sq. ft.

FINISHINGS

All the floors to these rooms should be laid with acid-proof materials. The floor to be laid to fall to channels to facilitate floor washing and all angles at junctions of walls with floor should be rounded off.

The walls to be provided with washable paint or tiles. The paint used must have special acid-resisting properties.

PLATE XXVII. Dispensary
Hospital Centre, Birmingham

PLATE XXVIII. Ward Blocks
Hospital Centre, Birmingham

[*To face page 152*

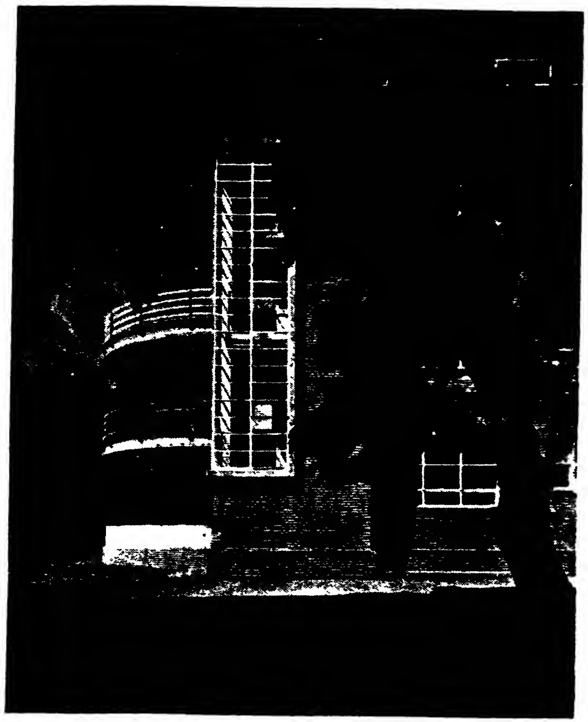


PLATE XXIX. Balconies
Royal Masonic Hospital, London

PLATE XXX. Sluice Room
Hillingdon Hospital

To face page 153]

18

The Medical and Surgical Wards

WARD UNITS which form the in-patient department proper are divided into many sub and cross divisions—men's; women's; children's; surgical; medical; gynaecological; special; septic; private, and so on.

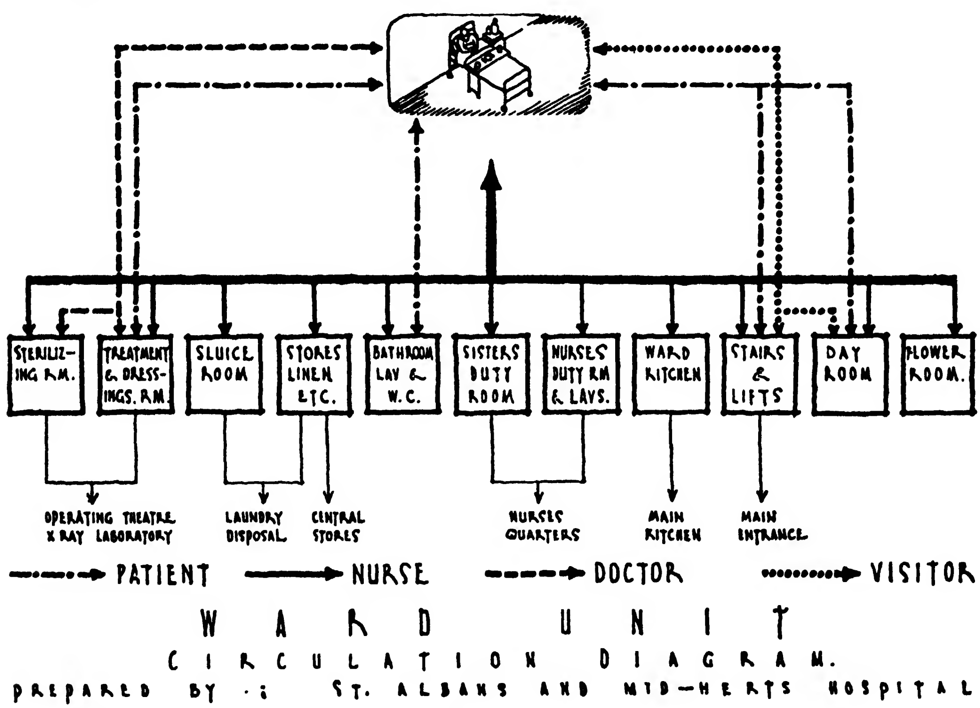


FIG. 66.

The planning of the ward unit, whether in a hospital of fifty or of several hundred beds, represents practically the same problem—how best can the comfort of the patient and accessibility of service be obtained?

Fig. 66 shows the relative circulation of patient, nurse, doctor, and visitor.

COMPOSITION OF A WARD UNIT

The ward unit may be defined as that area and number of patient beds with their accessory facilities which can be effectively supervised by one sister and which can be

properly served by one nurse on the night tour of duty. For reasons of economy, the ward unit should contain the maximum number of beds that one sister and one night nurse can supervise, while maintaining the personal knowledge of and interest in each patient which are essential for the success of their work. During day hours the number of nurses on duty can be adjusted to the number of patients to be cared for, but at night full utilisation of the nurse's time requires that the unit has provision for the maximum number of patients that one nurse can care for properly.

British practice for general hospitals has in the past been to provide up to thirty beds in one large ward, with two or three side wards. Much evidence in recent years is in favour of a drastic reduction in the size of the large multi-bed ward, and many consider the maximum size to be sixteen beds. The general tendency is to reduce, and it is reasonable to predict that eight-bed wards will eventually become the largest type of ward. There are many medical advantages in this sub-division, and many Continental hospitals are successfully planned with small ward units. Before long the public may insist on all wards being divided up into curtained cubicles so that privacy or the reverse can be readily obtained according to the desire of the individual. In wards the spacing of windows should be so arranged as to make this possible.

At least one of the outstanding American authorities now advocates all single wards, as he believes that the slightly increased cost of building and cost of nursing care are fully offset by the greater flexibility in the assignment of patients. In any multi-bed ward the patient must be of but one sex and good medical care requires some discrimination in bed assignment according to type of disease. One noisy or otherwise disagreeable patient or the patient's visitors may disturb the other occupants of the room, and in some cases a certain measure of other segregation may be deemed desirable. In all but the very large hospitals these various segregations may seriously decrease the actual utilisation of beds by the need for limiting the occupancy of some of the multi-bed wards to a single patient. On the other hand, once patients have passed the acute stages of their disease, it is not at all uncommon for them to prefer having one or more occupants in the ward as a relief from the loneliness they suffer in a single ward. The demand for single wards is likely to increase with the rise of cultural level of patients to be treated.

The maximum number of beds which one sister can supervise in an acute medical and surgical ward is considered by The Report to be thirty beds. It is emphasised that this number refers to acute general hospitals and not necessarily to other types of hospital. This is the deciding factor on the size of the ward, but the arrangement of these thirty beds is a subject on which there is much diverse opinion.

As regards the grouping of the beds, both extremes, namely the thirty beds in one ward and thirty single-bed wards, are rejected. To place these thirty beds in one large ward would be easy, but it is much more complicated if the number has to be split up into small wards. The final conclusion in The Report is that the unit should be sub-divided so that not less than four single-bed wards are provided, the remaining twenty-six beds being in either one ward of eighteen and two of four or one of fourteen and three

of four. This sub-division will, or course, increase the cost of the unit over the thirty-bed ward.

The small wards are necessary for the purpose of separation, for example, of noisy or otherwise disturbing patients; of those suspected of being infectious; of those who are in particular need of quiet; and of certain patients who are seriously ill or who have recently undergone serious operations.

In a surgical ward in which the turnover is rapid, it is useful to have one-third of a large ward nearest to the door cut off from the rest by a glass screen with glass swing doors. Patients are admitted to this section of the ward and remain in it until the day following operation, because it is during the day and night immediately after operation that they are most likely to be noisy and disturb others. But see Recovery Wards, discussed in Chapter 24.

It is difficult to give guidance as to the percentage of beds for the various classifications, as for instance in the case of towns where special hospitals exist, e.g. children's, eye, maternity, etc., the general hospital is less likely to make provision for such special treatment than if there were no such hospitals. The following percentages are based on the figures of fifty hospitals situated throughout the length and breadth of Great Britain, and the percentages of individual hospitals vary widely from the average. In consequence the percentage should not be taken as a guide to what is desirable in any one hospital.

	CLASSIFICATION	PERCENTAGE OF TOTAL
a	General surgical	43·1
b	General medical	19·7
c	Accident	1·8
d	Accident and orthopaedic	1·6
e	Cancer and radium	0·7
f	Children's beds not otherwise allocated	2·7
g	Ear, nose, and throat	5·6
h	Gynaecological	2·0
i	Isolation and septic	1·4
j	Maternity	2·4
k	Observation	0·2
l	Ophthalmic	3·7
m	Orthopaedic	2·2
n	Paying and private	6·0
o	Skin	0·3
p	Staff	0·4
q	Venereal disease	1·1
r	Others	0·2
s	Convalescent	4·9

It should be noted that the figures given are based on pre-war experience, an average distribution of patients as between the acutely ill and semi-convalescent. The present

tendency, and one which promises to persist in the post-war period, is to discharge patients earlier in their convalescence than was the practice before the war.

FRESH AIR AND SUNLIGHT

In addition to the size of the ward unit which it is considered one sister can satisfactorily supervise, there is another factor which radically affects the planning of the ward, namely the effect of fresh air and daylight. In recent years an extraordinary and even revolutionary change has taken place in the general appreciation, both by the medical profession and by the general public, of the values of fresh air and light, particularly sunshine.

Good daylighting is of great importance to hospitals for precisely three reasons:

a proper vision
b psychological effect
c protection from cross-infection.

As to vision, it is important in the hospital to be able to read a thermometer readily and to see abnormalities in colour of skin, lips, finger-nails, etc., and all the other symptoms in terms of which the most elementary clinical procedures are taught and practised. Equally important are the psychological factors. A moribund patient may be beyond caring whether the sun shines or not, but even this may not always be true. A very sick patient may at times prefer a low level of light; abundant light can be easily cut down to the desired level by using blinds. The average patient, however, particularly the long-term patient who must spend many weary days, weeks, or even months in a hospital, craves the cheerful play of daylight and a view of the sky.

The treatment of some diseases by exposure of the skin to the action of light, natural or artificial, has in a marvellously short space of time leapt from the obscure position of a somewhat contemptuously neglected specific to the status of one of the most valued and even invaluable weapons in the medical armoury. The proved efficacy of the Finsen lamp and its derivatives was quickly followed by general exposure of the bodies of patients to natural sunshine. The almost miraculous cures of rickets and of certain forms of tuberculosis in Alpine sanatoria by Rollier and others first fascinated medical opinion by their rapidity and completeness and then incited experimental repetition in less favourable localities. The achievements of the late Sir Henry Gauvain at Alton in Hampshire, which proved that altitude was not essential, paved the way for the general establishment of irradiation centres in hospitals, whilst the provision of a sun-room has become almost as much a recognised adjunct to the hospital as it was to the baths of ancient Rome.

Florence Nightingale lived to see the Red Cross movement firmly established in her lifetime; she also lived to see Netley Hospital built, and did not hesitate to condemn in no uncertain terms the waste of available sunshine involved in its design. Unfortunately, architects, in the absence of pressure from the medical profession, have been content for many years to consider that what was good enough for Netley was good enough for

them, so that until a few years before the 1939–45 War, we have seen the unedifying spectacle of solaria improvised on the outside escape staircases of famous hospitals, where, with a little forethought and common sense, entire wards might have been designed as solaria.

Florence Nightingale is quoted as saying that "all hospital buildings in England should be erected so that as great a surface as possible should receive direct sunshine, and that the window space should be at least one-third of the wall space." This was written in 1869, and as a result of her efforts the cross-ventilated hospital ward with a window on either side has given excellent results in the past. Hospital planning has, with few exceptions, become standardised, not to say crystallised or even fossilised, into the familiar ward, with its long axis running north and south with windows on each side facing east and west between beds placed at right angles to the external window wall.

Whilst public opinion is demanding the most ample admission of light, air, and sunshine to the interiors of domestic, factory, and office buildings, hospital wards are still being planned with over 60 per cent. of the external wall space taken up by solid wall and the windows so spaced that the patients receive the minimum of sunshine on their bodies and scanty maximum on their feet. It is gratifying to note that some architects are at last, although half a century too late, beginning to take advantage of Florence Nightingale's obvious common sense, and are considering whether some alternative design, both of windows and arrangement of beds, would not secure to the patients some of the sunshine and air which are wasted in the transverse type of ward.

In order to meet these requirements changes have been taking place in recent designs to increase the amount of sunshine, first by the elimination of the sanitary towers which usually flanked the balcony at the south end and still more recently by the introduction of the "longitudinal (veranda) layout," which results in a longer but narrower type of ward where the sun's rays have greater penetration. The longitudinal layout has the further advantage that the light is not directly in the patients' eyes, as in the transverse (standard) layout.

The Royal Institute of British Architects Report on the Orientation of Buildings is mainly concerned with the quantity of sunshine available for wards and says little about the quality, regarding which medical and physical research is still in active progress. It should not be forgotten, however, that sunshine in passing through ordinary window glass is robbed by absorption of a certain small group of ultra-violet rays which possess particular therapeutic and hygienic value. Fig. 67 indicates by contour lines the increased possible daily sunshine which can be obtained by adopting the longitudinal layout as against the transverse layout.

Except in the transverse layout where windows are restricted to the width of the space between each bed, wide window openings are now becoming popular, and in good weather the wards become in effect open-air sun-rooms, especially if the windows are of the type which allows a full clear opening. Sliding windows are attractive in their form, give a sense of space, and the large free openings are a delight

in fine weather. There is no doubt that they will become more popular in hospitals of the future in spite of their initial expense. With their use in small wards of a maximum of eight beds, assuming that the large ward becomes in time obsolete, it is doubtful whether the practice of providing long balconies outside the wards will be necessary.

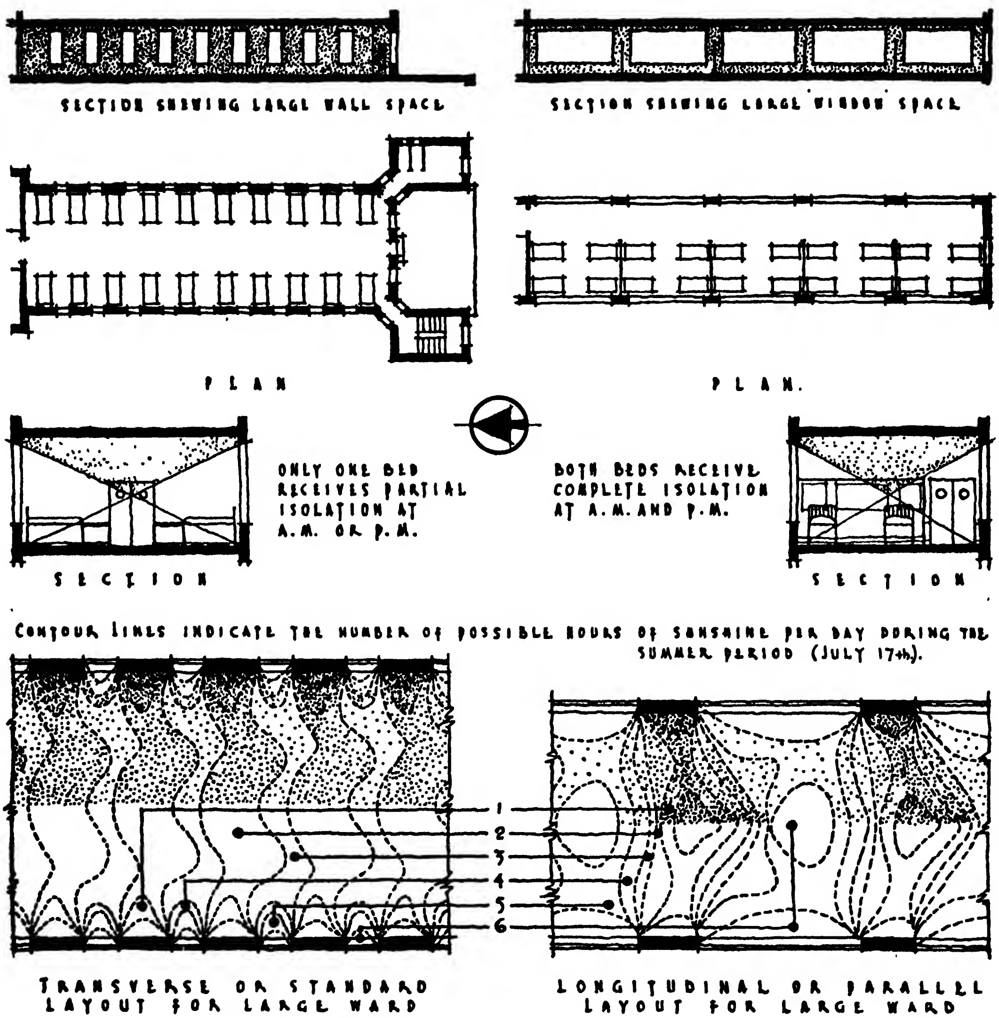


Fig. 67.

A better solution would seem to be to adopt sliding folding doors with narrow balconies or railings in the thickness of the wall, to take the place of normal wide balconies and avoid the movement of beds.

Many doctors question the universal advantage of sunlight as applying to all patients, and it would seem that sun-laden air is more desirable. British weather does not allow

full use of balconies and therefore it seems likely that only a limited number of wards will be provided with balconies for sun treatment.

This being so, the very controversial question of balconies in multi-storeyed hospitals, over-shadowing the windows below should solve itself, and there will be no need to resort to the very ingenious but expensive systems devised in Continental hospitals to overcome this difficulty. The systems referred to all follow the terrace system (see Fig. 1) and involve either an excess of accommodation on the lower floors or a very expensive cantilever form.

An alternative means of providing sun balconies is seen at the Paimio Sanatorium Finland, where the ward unit on each floor has a projected wing in terrace form on the east side (see Fig. 155). Such a terrace can only be conveniently used where a certain number of patients are fit enough to be out of bed for some part of the day. But the idea is worthy of fuller investigation.

It is necessary to emphasise that the maximum admission of sunshine must be considered in due relation to other considerations material to the efficiency of a hospital as a whole—economy in corridor length, the proper and convenient spacing of sanitary accommodation, etc.

TYPES OF WARDS

In recent years ward planning, once apparently established, has undergone much experimental revision. There are two principal points of view, namely, whether wards should be large or small and whether beds should be at right angles to or parallel with the long wards. This new era in ward design has begun, and there is a general desire to benefit by the work of experimentalists, provided that the results are based on sound lines and are likely to stand the test of time.

Even if enough light is brought into a ward under conditions that eliminate brightness contrast, the patients' comfort is not insured unless wards are planned with due regard for it. In the transverse layout there is generally a separate window for each bed. The patient lies with his head to the wall. The best light is at either side of the patient; the poorest immediately at his head, where light should be good for reading and medical examinations. What is worse, the patient is confronted across the ward by windows which permit the worst possible condition of glare and brightness contrast. A well person sometimes may be able to adjust his position in a room so as to avoid glare, brightness, contrast, and shadows, and at the same time to see the view out of the window. The bedridden seldom can; yet they should be the last to be called upon to endure avoidable discomfort—hence the longitudinal layout. If the patient wants to look outdoors he has but to turn his head. He does not have to look at the window if he does not wish to. Conditions for reading and working in bed, as well as light for examinations, are also good.

Briefly, for the purpose of classification, the forms of layout are (see Fig. 67):

a "transverse layout": in this type (the original standard layout) the long axis of the ward runs north and south; for many years the usual arrangement of

windows has been a window to each bed, the window being about 3′ 6″ wide, leaving a pier about 4′ 6″ wide against which is placed the head of the bed; the beds are placed in two rows at right angles to the external walls, and beds so placed receive a minimum of sunshine on the patients' bodies and a scanty maximum on their feet; the percentage of light in the ward is only about 30 per cent., so a sun-room or veranda is necessary in addition;

b "longitudinal layout": in this type (also known as veranda or shallow layout), beds are placed parallel to the side walls in groups of two or four separated by glass screens; windows are long, and of the sliding folding type, which allows the entire sides of the wards to be opened up in suitable weather for the free and full ingress of sunshine and air; the actual amount of wall mass now solid occupies only 8 per cent. of the wall surface, instead of 60 per cent. as in the transverse layout; the Science Committee of the R.I.B.A. found that the additional cost of maintaining minimum temperature in view of the large window area was immaterial; when it is essential to site the wards east and west, then the windows on the north can be reduced to a suitable size to give cross ventilation only; in the multi-storeyed hospital, sun-rooms and balconies are eliminated by this arrangement—the latter always shade and obstruct the windows of the lower floors; patients have a better outlook.

c "corridor layout": in this type, a series of wards is arranged along one side of a corridor with ancillary rooms on the other side. Windows, sun-rooms, and verandas as for the "longitudinal layout" apply.

The Report sets out very fairly the pros and cons of these layouts, and states that the longitudinal experiment has scarcely existed long enough at that time to justify positive statements as to the preference by patients. Points in favour of it are:

a it provides pleasanter and more comfortable conditions for patients; there is no down-draught on to the bed, and they can talk comfortably to one another;

b they can look out of windows, if the window sills are kept low. There is no constant glare from the windows opposite;

c particularly suited to wards with east to west axis in which, with the transverse layout of beds, half the patients face north;

d it lends itself to the division of wards, by screens, into groups of beds, thus affording, in a large ward, some of the agreeable features of a series of small wards;

e very sick patients can easily be screened off—and with beds placed on either side of a central corridor (Fig. 73) when they have visitors, any patient can enjoy more privacy than in the transverse layout.

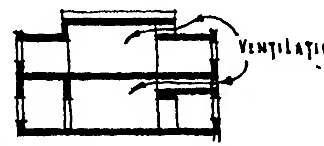
The longitudinal layout is now preferred by most hospital authorities, as it does at least give partial segregation. The principal advantage is, however, a psychological one, for instead of a patient lying in a long ward and seeing all day and every day a large number of comparative strangers in a state of ill-health, the patient is in a small group of, say, four with whom he can feel at home so far as his illness will allow. There is also

much less disturbance of other patients by one bad patient, by examinations and dressings of individuals, and, in general, the degree of privacy is greater. On the whole this type of ward is quieter than the transverse type.

The degree of ventilation and its controllability are considered excellent; the unpleasant smell of anaesthetics from patients recovering from operations is readily dispersed.

Supervision is not quite so easy as with the transverse layout, since the nurses cannot see from a distance the faces of those patients whose heads are towards them. The glazed upper panels of the screens should be at such a level as to enable the supervisory nurses, when standing up, to see what is fortunately invisible to patients lying down. One school of thought in nursing, however, holds that the nurses should patrol the wards rather than supervise from a distance; and as this layout adds so much to the comfort of the patient, the difficulty of supervision is not so great as appears at first sight, and can be overcome.

Finally, it is regarded as an interesting innovation, which does not appear likely to affect constructional costs materially, but will probably increase those of administration.



SECTION

SHOWING METHOD OF OBTAINING CROSS VENTILATION FOR ROOMS THAT ADJOIN A CORRIDOR

ASSUTAH HOSPITAL
TEL AVIV. PALESTINE

FIG. 68.

The movement towards small wards has led in some instances to the adoption of the Continental practice known as the corridor layout. This is a system of small wards ranged along one side of a well-lighted and ventilated corridor with ancillary rooms on the other. This form of planning gives the advantages of small wards, but has the disadvantage that supervision is not so good as in the large ward and that the wards are lighted and ventilated from one side only.

Good, natural ventilation must always receive due consideration, and as it is not practical, generally speaking, to provide more than one external wall to small wards, ventilation is usually arranged into the corridor, which must also be adequately ventilated. It is unlikely that British hospitals will ever have—or need to have—the elaborate air-conditioning plant provided in many American hospitals. To get cross-ventilation, fanlights are provided in the wall separating the ward from the corridor, and, being made to open, afford the necessary flow of air. For the sake of both lighting and ventilation, the other side of the corridor should be kept free of rooms for a part of its length. The Continental practice of ranging wards along both sides of the corridor is seriously prejudicial to lighting and ventilation, and should not be adopted unless very special siting necessitates.

In hot climates unusual consideration must be given to cross-ventilation and provision of good light, shielded from excessive sun. Fig. 68 shows the structural method employed in obtaining cross-ventilation for rooms that open from a corridor. A slit above first-floor ceilings and a set-back at roof level provides clerestory windows above the corridor height.

The Report states that it does not favour the six-bed ward, three beds deep, so common in Germany, as the deeper the ward the less efficient are the lighting and ventilation; and states that if the corridor layout is adopted, the wards should not be more than two beds deep. In many ways this is a suitable arrangement for the British climate, as the patients can be placed in the wards facing south. This allows large windows on the south and a corridor affording protection from the cold winds on the north. The central corridor, on the other hand, found in so many American and Continental hospitals, is not a feature favoured in this country, and in this respect British hospitals would appear to have advantage in point of cheerfulness and health.

The chief advantages of smaller wards over a single large ward are as follows:

a they provide greater quiet and privacy for the patients;
b they afford opportunity for classification of patients;

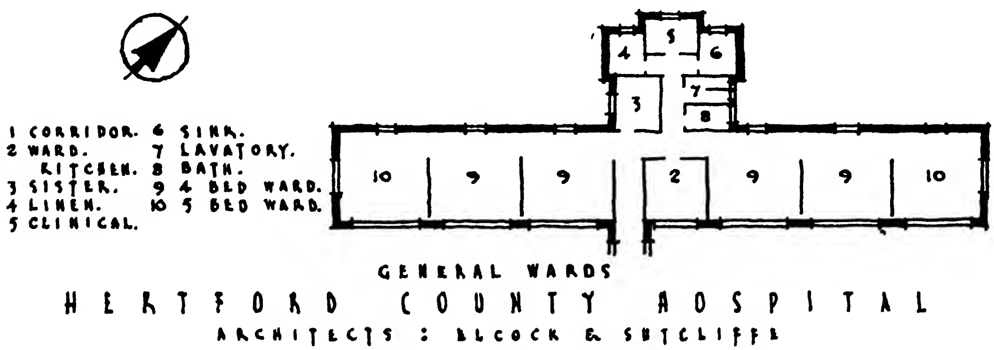


FIG. 69.

c they allow of elasticity by enabling certain wards to be used by children or adults, for medical or surgical cases, etc., according to the fluctuations in demand; it may also be possible to arrange that some wards can be used for either sex; this elasticity is an advantage of considerable importance and may conduce to a high percentage of occupation of all beds, with the subsequent saving in the number of beds provided;
d they limit the spread of infection, since if a case of infectious disease occurs in a small ward, a lesser number of patients are exposed to the infection; further, closure of a small ward on account of infection puts fewer beds out of action;
e they facilitate the periodical cleaning and redecoration of wards, because on occasions when wards have to be closed for these purposes, only a small number of beds need be out of commission at one time.

On the other hand, large wards have important advantages:

a they permit of a very simple and economical form of planning;
b they facilitate effective supervision of the patients by the nursing staff, and thus tend to economy in staffing;

c long, rectangular wards lend themselves readily to the provision of windows on opposite sides. This ensures good lighting of all parts, and not only permits of cross-ventilation and thorough flushing of the ward with air, but also enables windows on the sheltered side to be kept open even in boisterous weather. Thus the adoption of large wards is conducive to a high standard of lighting and ventilation, which in Britain, is regarded as of the greatest importance from the hygienic and therapeutic point of view.

At the Royal Masonic Hospital, London, there are no wards with more than four beds, except the children's wards, which are designed for eight. The wards are ideally finished, and each ward is sound-proofed and is provided with a fixed basin with hot

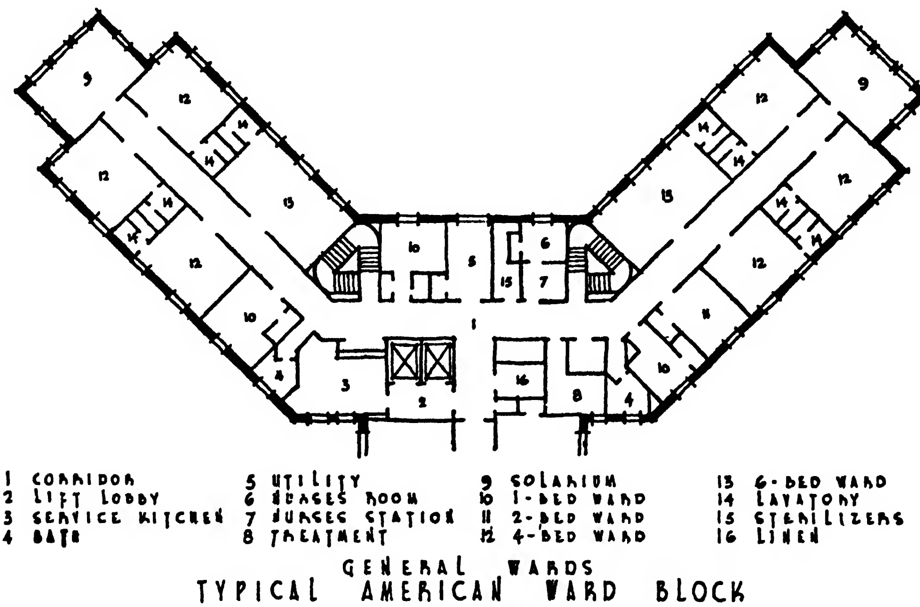


FIG. 70.

and cold water, designed lockers that are easy of access without strain or unnecessary movement, and beds that are high enough to allow the occupant to see out of the window, yet low enough for nursing efficiency. The temperature in each ward can be regulated according to the needs of the case.

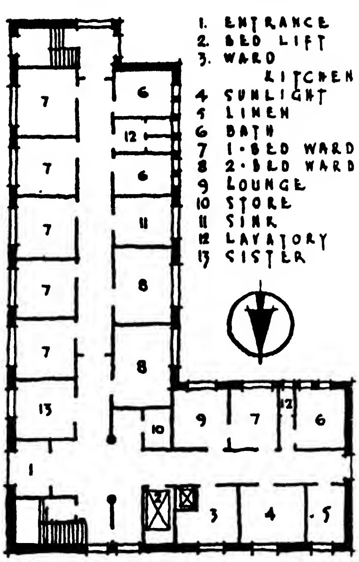
Figs. 69 to 72, 79 to 81, 85 to 89, and 98 are plans of hospitals in Great Britain, America, and Europe.

WARD DIMENSIONS AND BED SPACE

The Report was of the opinion that sufficiently exact data in respect of the cubic feet of air space per patient desirable on hygienic grounds were not available to make recommendations. Nevertheless, there was general agreement that height was relatively

unimportant in comparison with floor area and distance between bed centres; and, if adequate area per bed and, more especially, sufficient distance between adjacent beds are provided the demands of hygiene will be satisfied. A height of 11′ is sufficient for wards containing not more than sixteen beds, but for longer wards, if not divided by transverse screens, a height of 12′ is desirable. The height of the small wards and ancillary rooms will usually be determined by the height of the main ward, but where this does not obtain, 10′ is sufficient for small wards up to six beds and 9′ for single-bed wards.

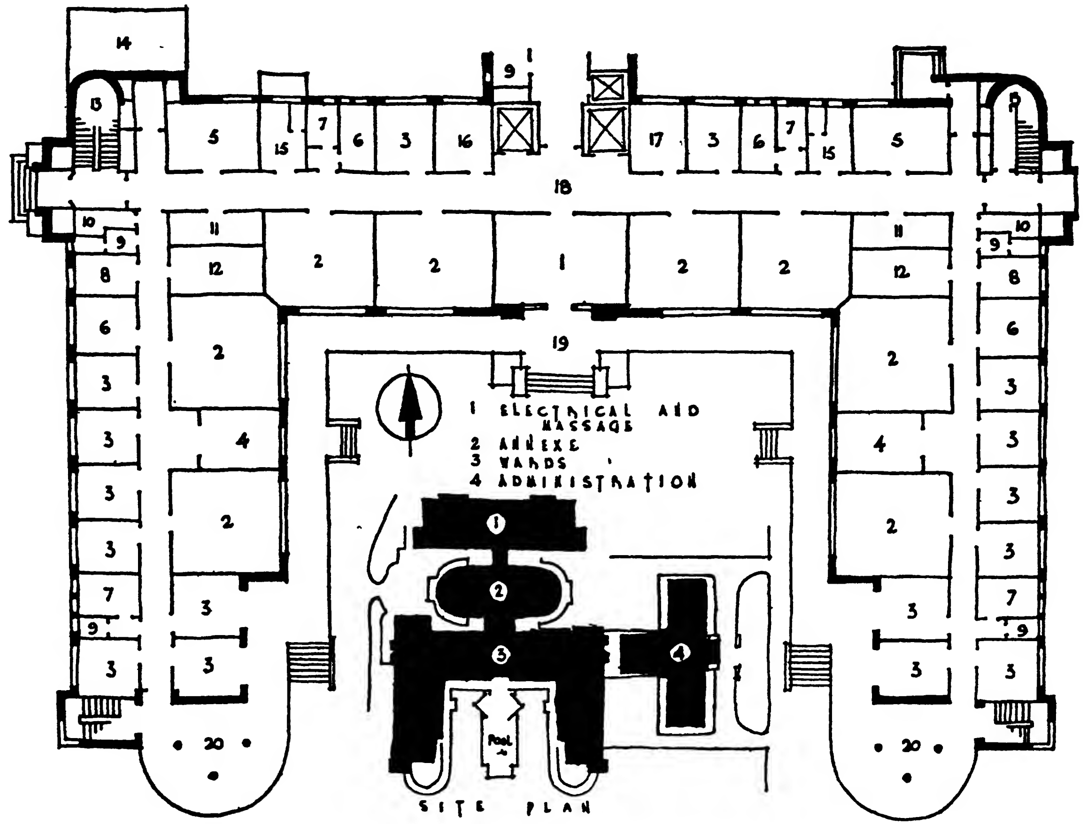
The distance between beds is regarded as of primary importance in connection with the danger of the spread of infection; but, on the one hand, while it appears that no reasonable amount of wall space would give absolute immunity from risk, the general agreement for convenience of nursing in acute medical and surgical wards is a wall space of 8′ per bed; this is considered to provide a high degree of safety from the spread of infection.



GENERAL WARDS
GERMAN HOSPITAL
· LONDON ·
ARCHITECTS: SIR. J. BURNET. TAIT & LORNE

FIG. 71.

The Report was unable to reach complete agreement upon the width to be adopted for the transverse layout. The minimum should be 24′ and the maximum 26′ (the latter has been adopted by the London County Council where furniture is fixed in the gangway). To provide a minimum of 100 sq. ft. per bed a width of 25′ is required. In determining the width of wards adequacy of working space of the ward is the most important consideration. The beds on each side of the ward project about 7′ from the walls and thus occupy about 14′ of the ward width, leaving, in a ward 24′ wide, a central space of 10′ between the two rows of beds. The main question to be decided is whether this is sufficient for convenient working after allowing for the central space partly occupied by furniture and equipment, and for ordinary traffic proceeding between the central equipment and the beds. This traffic is very considerable; the staff pass to and fro; patients, food, and the apparatus for various treatments have to be conveyed along the gangways, which must, therefore be wide enough to permit of the easy passage of beds and stretchers and the manipulation of trolleys. Provided the wards are not used for surgical cases where large fracture frames are required, the width could be reduced to 22′ without sacrifice of convenience or efficiency if a space represented by the omission of one bed be used instead for equipment, e.g nurse's chair, steriliser, etc., or if equivalent space is added to the ward area by the provision of a bay. In teaching hospitals it will be desirable to have wards 26′ wide to provide sufficient accommodation for students or pupil midwives.



1 RECREATION
2 4-BED WARD
3 1-BED WARD
4 SISTER
5 WARD KITCHEN.
6 BATH
7 SLUICE
8 SINK
9 PATIENTS W.C.
10 BROOM CUPBD.
11 LINEN
12 PATIENTS CLOTHES
13 LIFT MOTORS
14 LOADING PLATFORM
15 NURSES LOCKERS
16 CLINICAL RESEARCH
17 WAITING
18 CORRIDOR
19 TERRACE
20 SUN BALCONY

GENERAL WARDS
ROYAL MASONIC HOSPITAL· LONDON
ARCHITECTS· SIR J. BURNET TAIT & LORNE

Fig. 72.

As regards the most suitable dimensions for the longitudinal layout, The Report does not prescribe standards. The wards at Hertford County Hospital are 20′ wide and the beds are arranged in groups of four at one side of the ward, with a lateral service gangway. The distance between screens is 20′. At Southend-on-Sea General Hospital the beds are arranged along each side of the ward with a central gangway, and transverse screens on each side divide the beds into groups of two. The distance between screens is 18′ and the width of the wards 22′. It will be observed that in these two examples, the floor area per bed differs by only 1 sq. ft. Whereas the accepted standard by the Ministry of Health for bed space, expressed in terms of superficial area per bed, is a minimum of 100 sq. ft., single-bed wards require a slightly larger area than allowed in multiple wards. A suitable size is 10′ by 11′.

The area of the ward unit, containing a main ward of twenty-six beds and four one-bed wards, recommended by The Report is as follows:

	AREA IN SQ. FT.	
Main ward (105′ by 25′)	2,625	
Four small wards (each 11′ by 10′)	440	
		3,065
Ancillary rooms of the areas given in this Chapter	810	
Patients' lavatory and W.Cs., staff lavatory and W.Cs., Cleaners' room, corridor, and partitions	830	
		1,640
Total area of ward unit within outer walls		4,705

It will be seen that of the total area, slightly less than two-thirds is occupied by wards. In the above figures, no allowance is made for staircases and lift, nor for a veranda or balcony.

Finally, if all the floors of the ward unit have the same plan, this permits standardisation of construction and of all services. Moreover, if the ward kitchens and the bathrooms, etc., are not only vertically grouped, but also grouped in relation to each other on every floor, they can use the common duct (accessible on each floor) through which all the piping runs.

WARD DATA ANALYSED

See Fig. 73 for diagrams indicating types of large ward layout

	Type of Ward Layout		*Dimensions*
a	bed at right angles to wall (transverse layout), central passage	*a*	wards 22′ to 26′ wide, beds at 8′ centres
b	beds parallel to walls (longitudinal layout), low screens, central passage	*b*	wards 20′ to 22′ wide, bays at 18′ to 22′ centres for four beds; the 22′ bay in surgical wards only

Type of Ward Layout		*Dimensions*	
c	beds parallel to walls, low screens, side passage	*c*	as for (*b*)
d	beds parallel to walls, low screens, side corridor screened off	*d*	as for (*b*)
e	beds parallel to walls, low screens, centre corridor screened off	*e*	wards 38′ to 40′ wide, bays at 20′ centre for eight beds
f	beds at right angles to walls, double width ward	*f*	wards 54′ by 45′ wide, beds at 8′ centres; contains twenty-four beds

See Figs. 75 and 76 for diagrams indicating types of small ward layout

Type of Ward Layout		*Dimensions*	
a	one-bed ward	*a*	minimum: 11′ by 10′; 12′ by 9′ usual: 12′ by 10′; 13′ by 11′; 14′ by 12′
b	one-bed ward with lavatory basin and lockers		
c	two one-bed wards with separate W.Cs. and common bathroom		
d	two one-bed wards with separate W.Cs. and separate lockers		
e	two one-bed wards with separate lavatory basins and W.Cs.		
f	two-bed wards, side by side	*f*	minimum; 16′ by 12′ 6″ usual: 16′ by 16′
g	two-bed wards, opposite but staggered	*g*	minimum 15′ by 14′ usual: 16′ by 15′
h	two-bed wards, exactly opposite	*h*	minimum: 18′ by 11′ usual: 18′ by 15′
i	two-bed wards, one facing window, one parallel	*i*	minimum: 15′ by 14′ usual: 16′ by 15′

Approximate areas, cube allowance per bed, and spacing of beds

	INFANTS	CHILDREN	SURGICAL, MEDICAL	MATERNITY	ISOLATION
a one-bed ward					
area, sq. ft. ..	—	—	130–160	150–200	140
cube, cu. ft. ..	—	—	1500	1500	1600
b two three-bed ward					
area, sq. ft. ..	—	—	110–125	140–180	140
cube, cu. ft. ..	—	—	1250	1400	1600

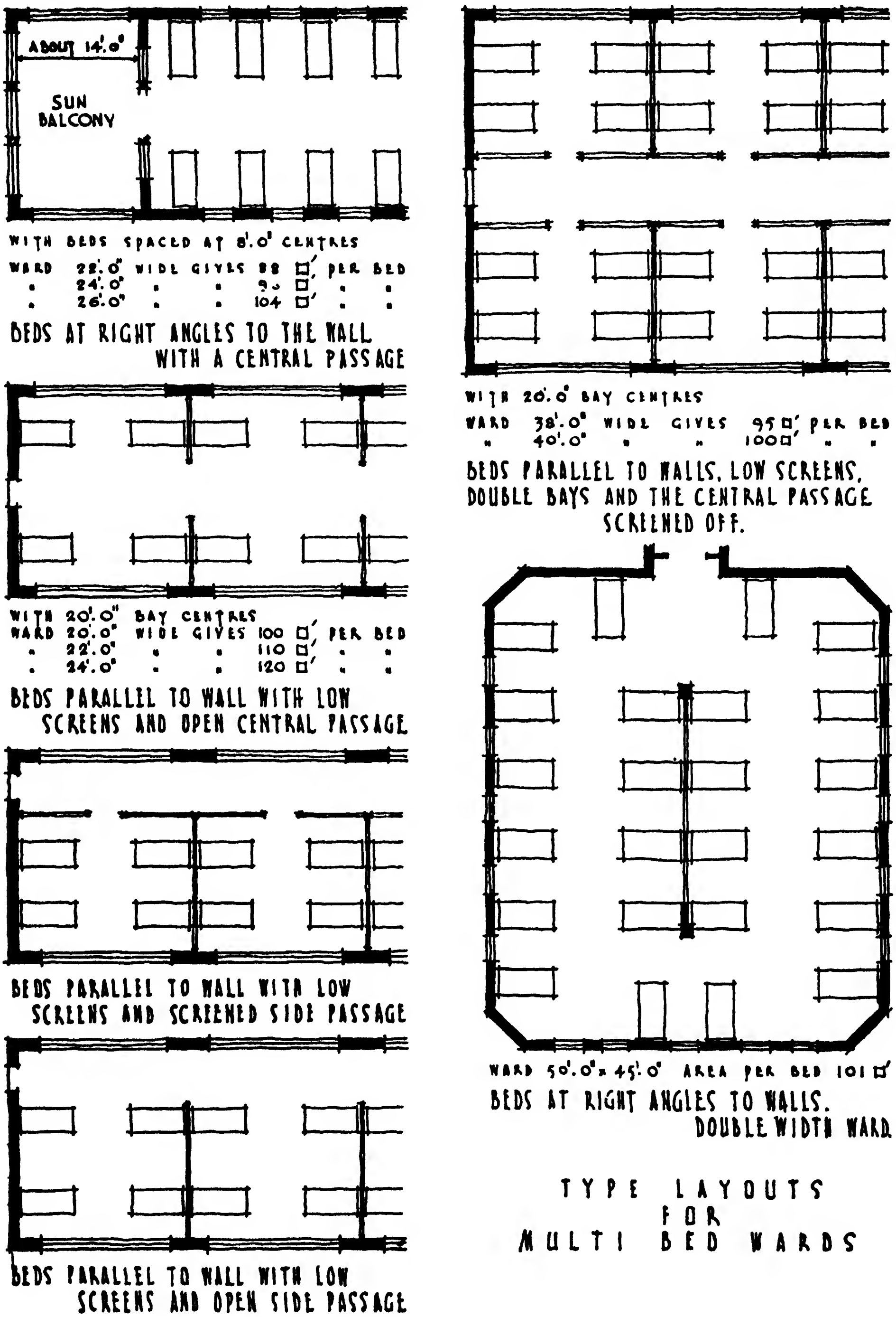

ABOUT 14'.0"
SUN BALCONY
WITH BEDS SPACED AT 8'.0" CENTRES
WARD 22'.0" WIDE GIVES 88 □' PER BED
" 24'.0" " " 96 □' " "
" 26'.0" " " 104 □' " "
BEDS AT RIGHT ANGLES TO THE WALL WITH A CENTRAL PASSAGE
WITH 20'.0" BAY CENTRES
WARD 20'.0" WIDE GIVES 100 □' PER BED
" 22'.0" " " 110 □' " "
" 24'.0" " " 120 □' " "
BEDS PARALLEL TO WALL WITH LOW SCREENS AND OPEN CENTRAL PASSAGE
BEDS PARALLEL TO WALL WITH LOW SCREENS AND SCREENED SIDE PASSAGE
BEDS PARALLEL TO WALL WITH LOW SCREENS AND OPEN SIDE PASSAGE
WITH 20'.0" BAY CENTRES
WARD 38'.0" WIDE GIVES 95 □' PER BED
" 40'.0" " " 100 □' " "
BEDS PARALLEL TO WALLS, LOW SCREENS, DOUBLE BAYS AND THE CENTRAL PASSAGE SCREENED OFF.
WARD 50'.0" x 45'.0" AREA PER BED 101 □'
BEDS AT RIGHT ANGLES TO WALLS. DOUBLE WIDTH WARD.
TYPE LAYOUTS FOR MULTI BED WARDS

FIG. 73.

		INFANTS	CHILDREN	SURGICAL, MEDICAL	MATERNITY	ISOLATION
c multi-bed ward						
area, sq. ft.	..	50	75	100–110	100–130	140–160
cube, cu. ft.	..	—	—	1150	1300	1800
d spacing of beds, ft.	..	—	7	8	10	12

e normal ward fittings:

(i) size of beds .. average 6′ 6″ by 3′
minimum 6′ 6″ by 2′ 6″

(ii) size of cots .. 4′ 6″ by 2′

(iii) size of combined bedside table and locker
minimum 1′ 8″ by 1′ 4″
average 1′ 8″ by 1′ 8″
ample 2′ 0″ by 1′ 8″

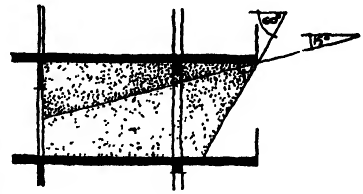


FIG. 74.

VERANDAS AND BALCONIES

Verandas and balconies may be used either for temporary occupation in suitable weather or for permanent occupation by patients undergoing open-air treatment, or both. If they are to be used for permanent occupation, they should be completely enclosed (but with sliding windows giving the maximum possibility of open-air conditions), and should be provided with artificial lighting and some form of heating. The verandas then become in reality sun-rooms or solaria.

The question of balconies and windows is almost as important as the arrangement of the wards. The number of patients able to use an open-air balcony in fine weather is given as:

a 40 per cent. for medical wards
b 50 per cent. for surgical wards
c 90 per cent. for children's wards.

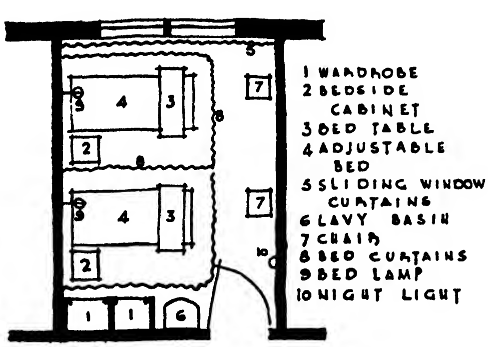
An open-air balcony running along the south side is ideal as far as the exposure is concerned, but if repeated on several floors has a bad effect in shutting out light and air from the wards. It is said that a 3′ projection will reduce the light in the adjoining lower ward by 25 per cent. One must nevertheless remember that in the winter the sun never rises above 15 deg. from the horizon. In mid-summer, when it rises to 60 deg., balconies are useful as sun-blinds without impeding the air in the slightest (see Fig. 74). Even north balconies can be extremely useful, for in the summer the sun gets on to the north side at 3.30 p.m. and there is as much benefit from ultra-violet rays in an unobstructed north aspect as in any other. Often in hot weather, particularly for children and babies, it is better to be in the shade than in the hot sun.

The "terrace" system of construction has been freely adopted on the Continent, and has resulted in very interesting designs, particularly where these "terraces" are connected to the ground by flights of staircases—the staircases affording alternative

means of fire escape. But the terrace system is an expensive method of construction and leads to a great waste of space on the lower floors unless the floors are cantilevered over on the north side, somewhat in the manner of the overhanging storeys of a medieval city (see Fig. 1). However, in the days of financial stringency to come, these expensive experiments are unlikely. Another solution for a unit of many floors is to adopt french windows in the thickness of the walls, with narrow balconies and railings, so that the bed can project about 2′ (see Fig. 81).

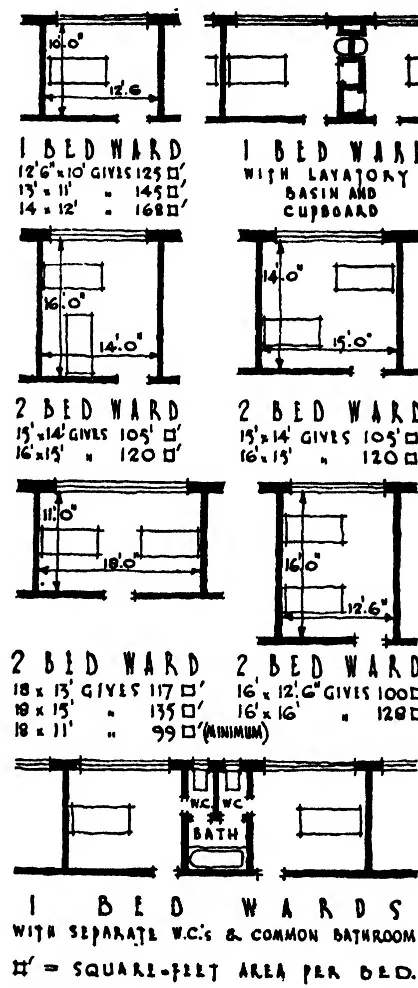
The vertical type of hospital in its American form ignored the requirements of balconies on the grounds of the rigour of the American climate, where temperatures of 100 deg. F. in summer and several degrees below zero in winter are not uncommon.

The Report states that verandas or balconies should be placed at the end rather than at the side of the transverse layout of a ward block, and that they may form an expanded end to the ward block; but, in order to avoid obstructing the side windows, their depths should not greatly exceed that of the ward. The end of the veranda



TYPICAL TWO-BED WARD

FIG. 75.



TYPE LAYOUTS FOR 1 AND 2 BED WARDS

FIG. 76.

can be developed to incorporate the escape stairway for the alternative means of exit.

The minimum width of balconies should be 9′, as this only just allows sufficient passage at the foot or head of the bed. The recommended depth (front to back), is about 14′. When railings are provided, they must be designed to make it easy to sweep off the dust collecting on the balcony. A gutter is also required to collect surface water.

Where glazed roofs are used, ample means of ventilating the upper portions of the veranda must be provided, otherwise stagnant air may become trapped, with most deleterious results. In this connection it may be noted that glazed roofs inclined upwards to secure the maximum admission of sunshine to the wards from which the verandas open, with a valley gutter next the wall, in place of the usual glazed lean-to roof sloping downwards from the ward wall with a gutter along the outer edge, constitute the best preventive of stagnant air pockets (see Fig. 77).

At the Faith Hospital, St. Louis, U.S.A., the balconies are in reality projecting hoods of a depth such that they keep out the sun in summer and provide maximum

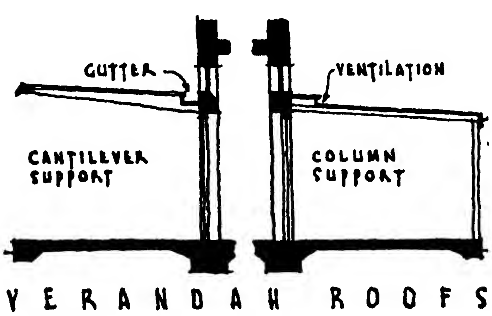


FIG. 77.

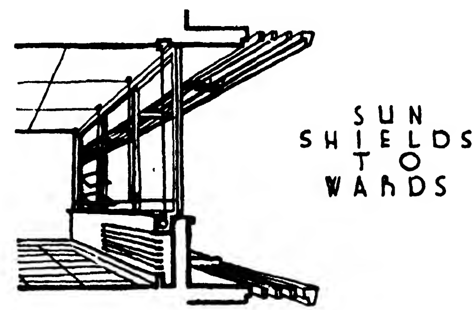


FIG. 78.

penetration in winter. In addition, these balconies serve as platforms for window cleaning (see Fig. 78).

SUN-ROOMS AND SOLARIA

The disappearance of the sanitary annexe from the south end of the wards has made wide sun-rooms possible and has given a great sense of openness to the plan generally. It has become the normal practice to provide these sun-rooms in conjunction with the transverse layout of beds and with this type of ward, generally speaking, the use of sun balconies and sun-rooms will doubtless increase. The objection to a glazed sun-room is that this in time is likely to be used as part of the ward, and a further sun-room has to be added if the site allows, so that the process may go on indefinitely.

There is no end to the variety of possible arrangements for the wards with balconies and sun-rooms. The sun-room particularly is a most interesting architectural problem, and needs very careful designing. The cast-iron balcony type, with glazed roof, is not a satisfactory termination to a ward, though it has the advantage of being light in construction and does not obstruct the light. Concrete construction has assisted the architect in freeing the design of many stanchions, and has made possible the design of a sun-room with wide openings which can be filled with sliding windows for use in bad weather, thereby giving the maximum possibility of open-air conditions.

Artificial lighting and some form of heating should be provided.

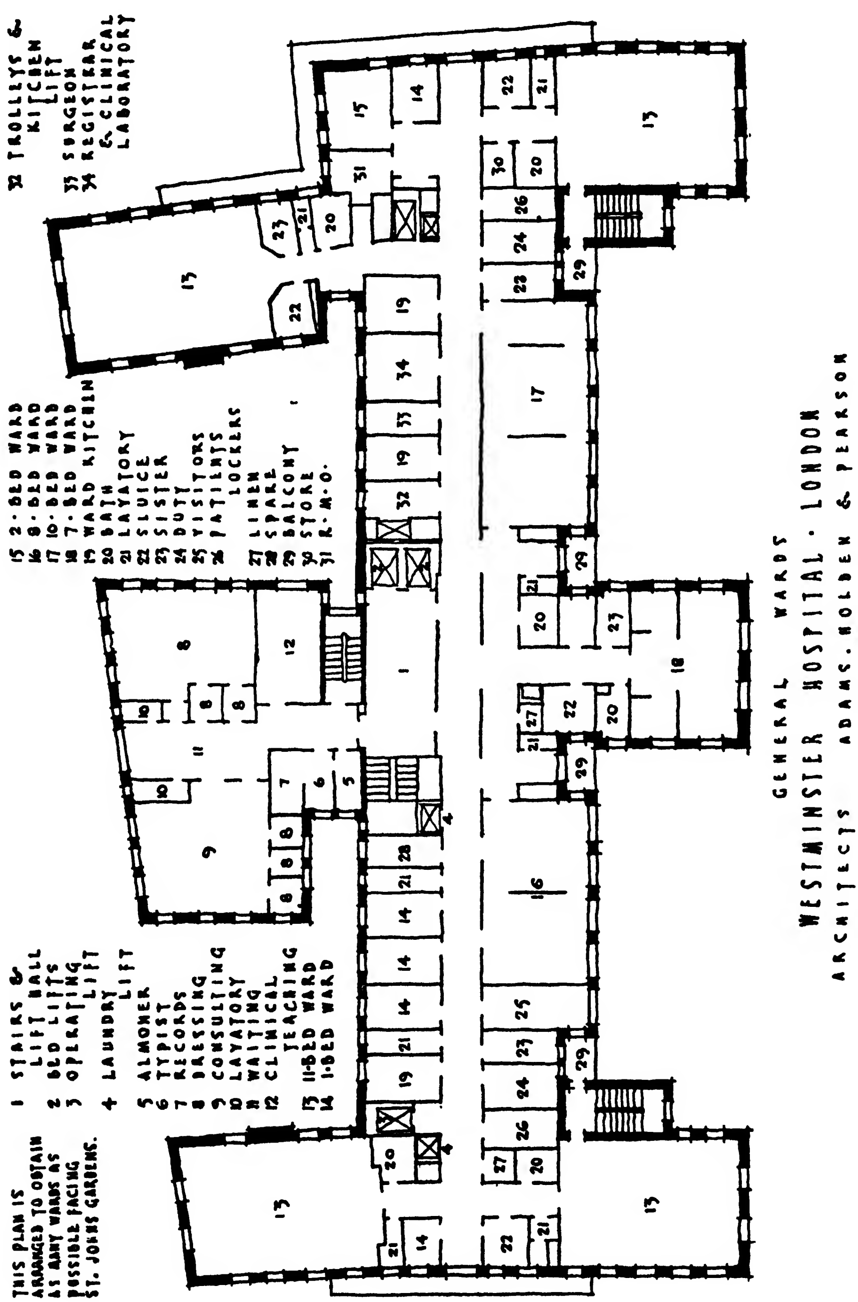

THIS PLAN IS ARRANGED TO OBTAIN AS MANY WARDS AS POSSIBLE FACING ST. JOHNS GARDENS.
1 STAIRS & LIFT HALL
2 BED LIFTS
3 OPERATING LIFT
4 LAUNDRY LIFT
5 ALMONER
6 TYPIST
7 RECORDS
8 DRESSING
9 CONSULTING
10 LAVATORY
11 WAITING
12 CLINICAL TEACHING
13 11-BED WARD
14 1-BED WARD
15 2-BED WARD
16 8-BED WARD
17 10-BED WARD
18 7-BED WARD
19 WARD KITCHEN
20 BATH
21 LAVATORY
22 SLUICE
23 SISTER
24 DUTY
25 VISITORS
26 PATIENTS LOCKERS
27 LINEN
28 SPARE
29 BALCONY
30 STORE
31 R·M·O·
32 TROLLEYS & KITCHEN LIFT
33 SURGEON
34 REGISTRAR & CLINICAL LABORATORY
GENERAL WARDS
WESTMINSTER HOSPITAL · LONDON
ARCHITECTS ADAMS. HOLDEN & PEARSON

Fig. 79.

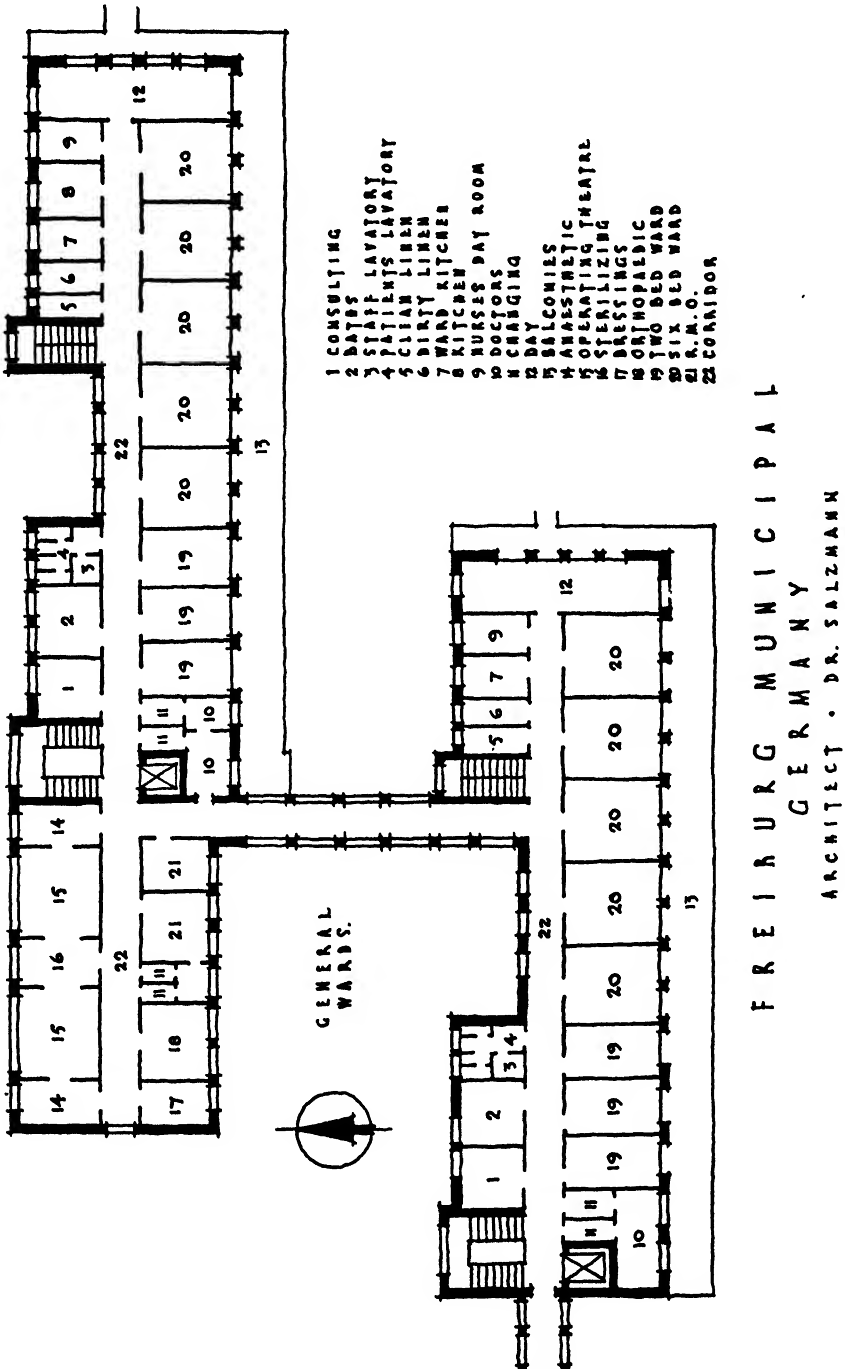
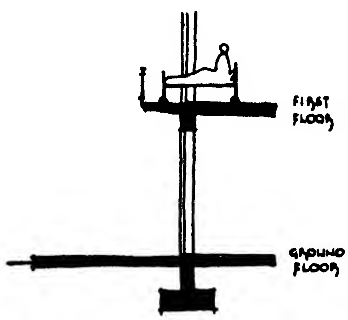

1 CONSULTING
2 BATHS
3 STAFF LAVATORY
4 PATIENTS LAVATORY
5 CLEAN LINEN
6 DIRTY LINEN
7 WARD KITCHEN
8 KITCHEN
9 NURSES DAY ROOM
10 DOCTORS
11 CHANGING
12 DAY
13 BALCONIES
14 ANAESTHETIC
15 OPERATING THEATRE
16 STERILIZING
17 DRESSINGS
18 ORTHOPAEDIC
19 TWO BED WARD
20 SIX BED WARD
21 R.M.O.
22 CORRIDOR
GENERAL WARDS.
FREIBURG MUNICIPAL
GERMANY
ARCHITECT · DR. SALZMANN

Fig. 80.

ROOF FACILITIES

The flat roof is a characteristic of this new phase of hospital design and construction, and from a practical point of view it has great advantages as there is no waste of space and it can be used by patients for exercising or open-air treatment on restricted sites. The question of the construction of the flat roof is considered in Chapter 36.

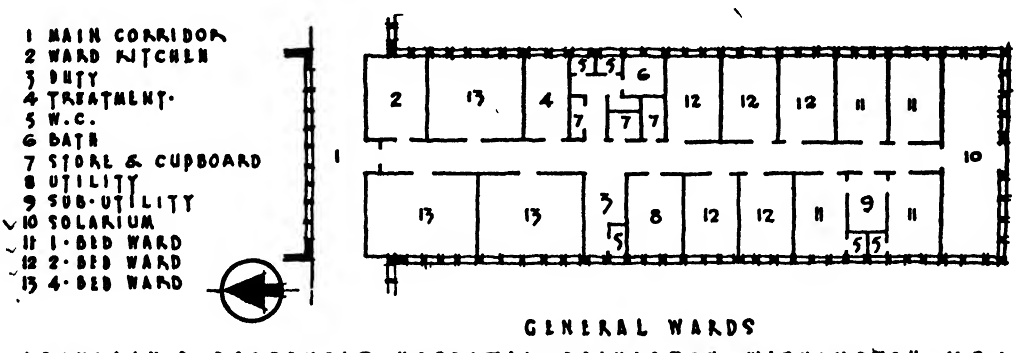


SMALL BALCONY PROJECTION TO UPPER FLOORS

FIG. 81.

Alternative escape stairs must be provided, and parapet walls with glazed screens of sufficient height to prevent any possible accident are required if the roof is to be used for permanent occupation by patients undergoing open-air treatment.

The bed-lift must be carried right up, so that it is possible to bring the beds up to that level. A small portion of the roof space should be roofed in and have a movable glazed front. As this could, in suitable weather, be used as a ward, sanitary conveniences and a bath, etc., will be required.



FRANKLIN D. ROOSEVELT HOSPITAL : BREMERTON : WASHINGTON U.S.A.
ARCHITECTS: F. A. NARAMORE, C. GRAINGER, C. J. BRADY AND P. B. JOHANSON

FIG. 82.

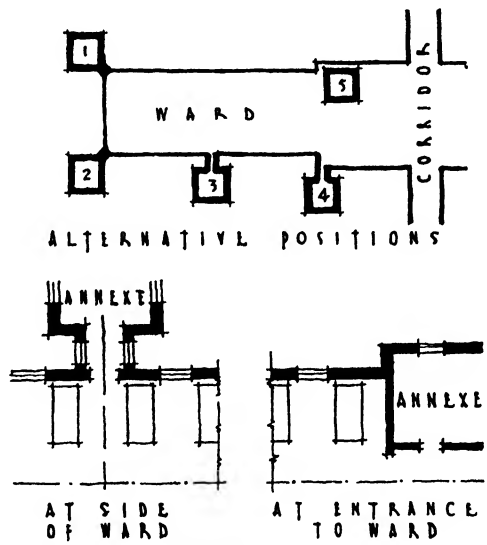
ANCILLARY ROOMS TO A WARD UNIT

The ancillary accommodation required to serve one ward unit has remained very much the same for a considerable number of years, as ordinary nursing routine seems to change very little. The convenience of the ancillary rooms is very important as their relation with the wards obviously determines the number of feet the nurse must travel between the bedside and such facilities as she must use, particularly the sluice room.

If it is 60′ from the bed to sluice the nurse must travel twice as far for each service as she would if it were but 30′. This increase of travel distance reduces by just so much the time the nurse can spend at the bedside.

The position of the sanitary annexe in relation to the ward has in recent years been the subject of much discussion. The cross-ventilated lobby is no longer insisted on to the same extent as in the past, partly owing to the confidence felt in modern plumbing and partly on the grounds of cost; therefore the best position seems to be at the entrance to the large wards, in which position the annexe is conveniently placed both for the large and small wards and for staff supervision.

Sanitary towers or annexe wings which projected from the side of the large ward, and for so long blocked the south-east and south-west angles of the south end of the ward are admittedly undesirable, as they are obstructive to sunlight and air (see Fig. 83). With the passing of the sanitary towers goes the cut-off lobby. Theoretically these served as cut-off cross-ventilation between the ward and the sanitary annexe; actually the windows caused a chill draught to the patient passing from the ward to the annexe and the windows were consequently kept shut.



ALTERNATIVE POSITIONS FOR SANITARY ANNEXE

FIG. 83.

Sanitary annexes should not be smelly places, and indeed no longer are. The bed-pan is offensive during its passage to the sluice-room, and the journey should be made as short as possible from the farthest bed. In recent years considerable improvements in the planning of these rooms have been made, and by careful study these improvements can go still further.

The London County Council consider the main sanitary annexe should be directly accessible from the main ward and service corridor and as a nurse should not be required to carry a bed-pan beyond the distance normally occupied by eight beds (i.e. 64′); if the length of the ward makes this impossible, a subsidiary sanitary annexe is necessary.

The Report states that the following rooms appear to be necessary in a ward unit; the areas given will be to some extent affected by the exigencies of planning:

a	lighted recess or day-room	100 sq. ft.
b	ward office	70 sq. ft.
c	ward kitchen	200 sq. ft.
d	duty-room	100 sq. ft.
e	sluice-room	100 sq. ft.

f	space for testing	30 sq. ft.
g	patients' lavatory and W.Cs.	—
h	staff lavatory and W.C.	—
i	bathroom	70 sq. ft.
j	linen-room	70 sq. ft.
k	general store	70 sq. ft.
l	cleaners' room	—

The ancillary rooms mentioned in the foregoing paragraph are those considered to be necessary in a municipal hospital of the first class; they might not entirely meet the needs of some hospitals, and might not all be required in others, but The Report states they appear to constitute a good standard.

Provision of some fairly convenient and well equipped rest-rooms for working personnel is now receiving increased attention. Such provision is not necessary for

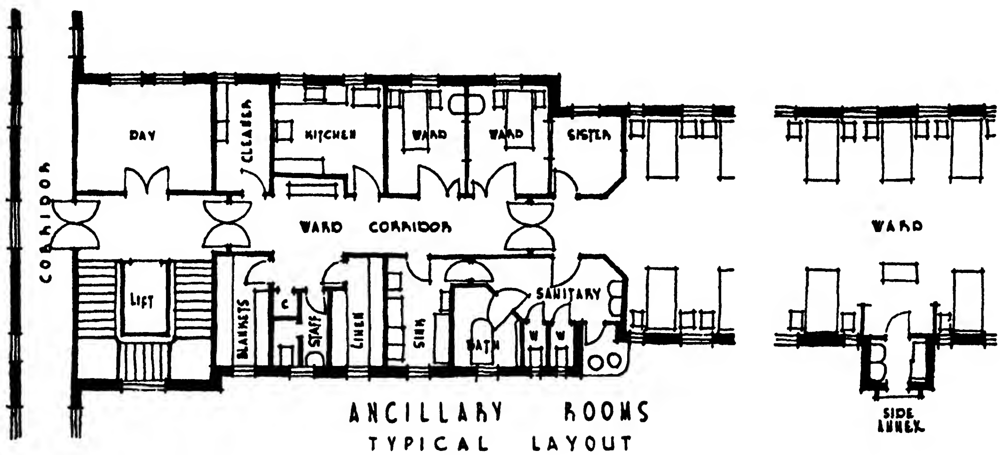


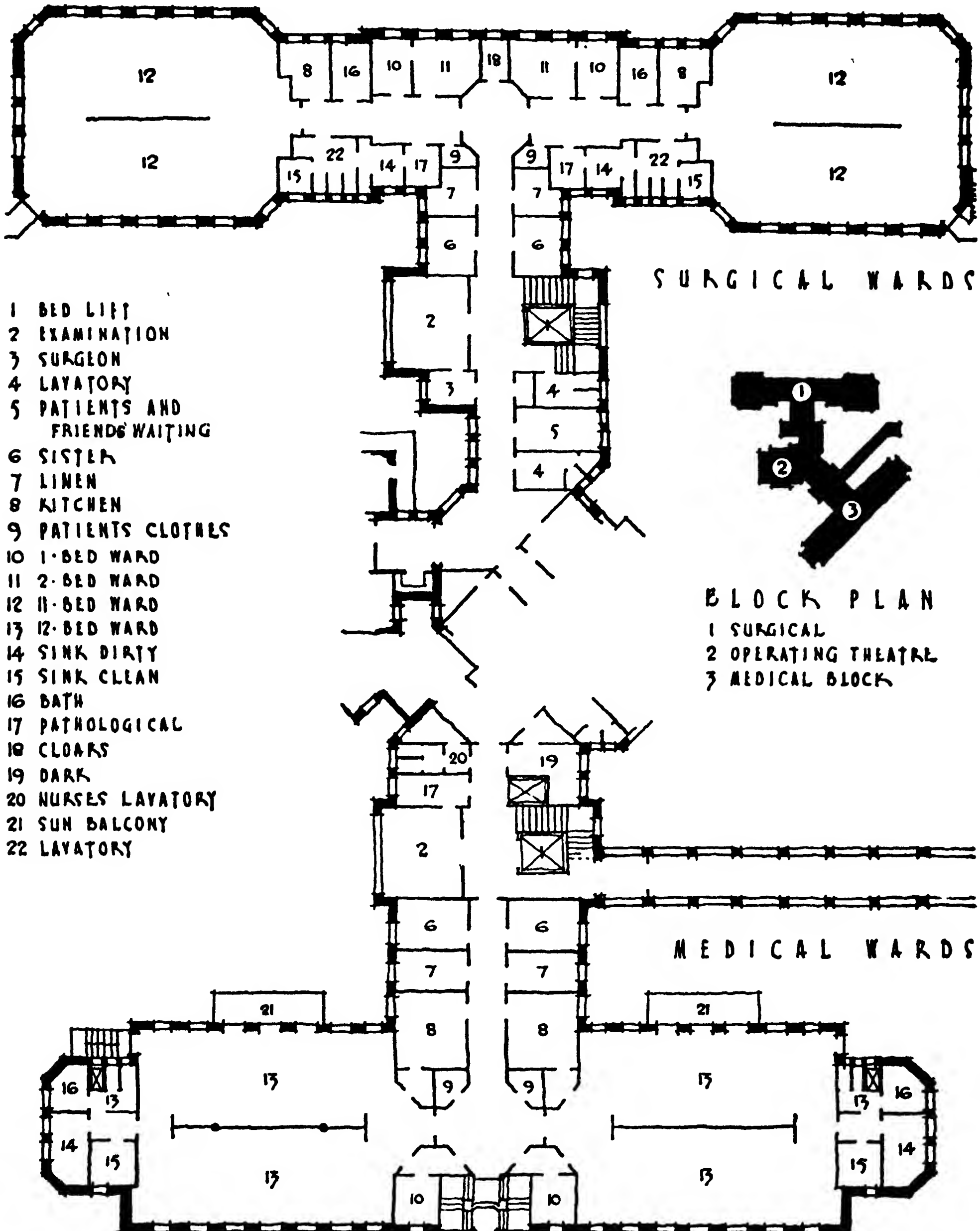
FIG. 84.

each individual ward or floor of the hospital, but they should be sufficiently convenient to each section to obviate too much travel or too long an absence from the post of duty.

In some large hospitals where large numbers of surgical cases are treated, an X-ray room with a small dark-room for developing the photographs is considered a valuable asset, for it avoids the necessity for transferring the patients to the main radio-diagnostic department for such purposes as the setting of fractures and the removal of foreign bodies. Normally portable X-ray apparatus is sufficient for this purpose.

At St. Bartholomew's Hospital, London, the last ward units erected had their own kitchen, clean-sink room, dirty-sink room, urine-testing room, bathroom, lavatories, clothing store, linen-room, and sisters' sitting-room. In addition, serving every two units (total of fifty beds), there is a large demonstration room, a surgeons' room, and a waiting-room for the friends of patients. A special examination room with a small room adjoining for the personal use of the surgeon is also provided (see Fig. 85).

Fig. 84 is a typical layout for ancillary rooms.



MEDICAL & SURGICAL WARDS

ST. BARTHOLOMEWS HOSPITAL: LONDON

ARCHITECTS: : LANCHESTER AND LODGE

FIG. 85.

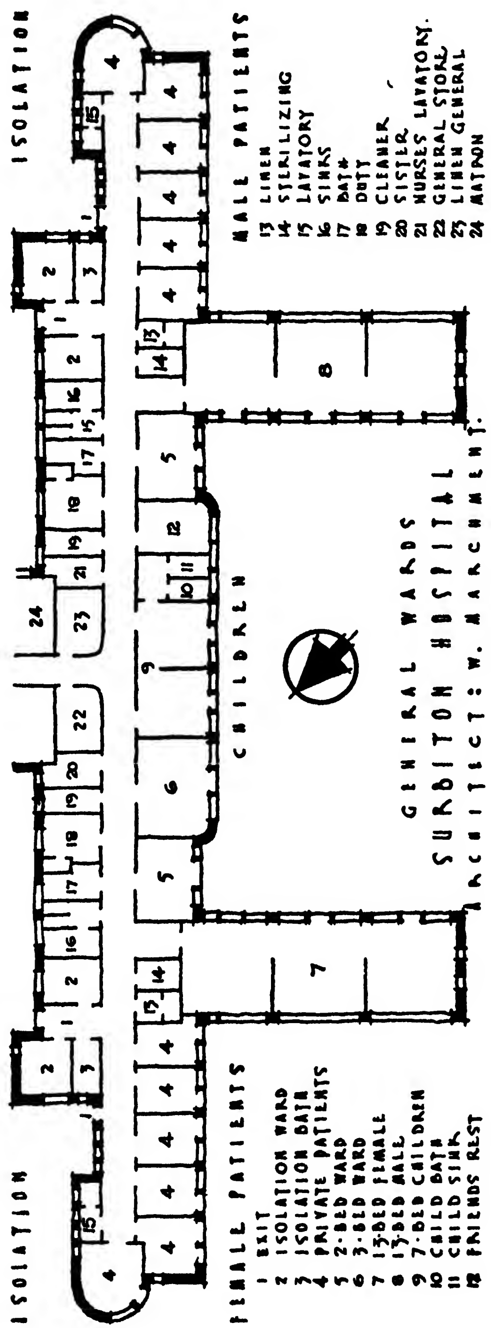


Fig. 86.

Branch Corridor. This leads to the large ward and should be 7′ wide, to facilitate wheeling beds or stretchers into side wards.

Incorporated in this corridor can be the lighted recess to be referred to. Also accommodation in the form of a recess should be provided for at least one patients' trolley. Each unit, or at least each floor, should be provided with a parking space capable of accommodating at least one wheeled trolley and one wheel chair. The number for which provision must be made will vary somewhat with the character of cases to be treated in particular departments. The number of wheel chairs needed may be much greater in surgical or particularly fracture or orthopaedic wards than in medical wards. Also, the increasing practice of taking surgical patients from their wards to the operating theatre, rather than of transferring them to trolleys, has decreased the need of trolleys. The same holds true in the case of transporting patients to the reontgenological or other special diagnostic or therapy departments.

Chapter 5 considers in detail the necessities for main corridors, and these are also applicable to the ward branch corridors.

Lighted Recess and Day-room. Space must be provided either in a separate room or in an alcove for waiting visitors. Similar provision, a solarium for instance, is needed in sections of the hospital in which there is likely to be a large number of ambulatory or semi-ambulatory patients. The day-room is an unsatisfied need in the majority of hospitals in Great Britain. Because of

this many patients are kept in bed too long, for when they are out of bed there is nowhere for them to go or sit and they feel they are a nuisance to everyone.

The number of patients who are able to be up in a ward unit of acute cases is not large, therefore a room or large recess which could be provided with a fire should be provided off the corridor.

Where ancillary and small wards are arranged along the two sides of a corridor of any considerable length, it is necessary to leave a free space, at least on one side, to allow direct access of light and air to the corridor. This might take the form of a fairly large lighted recess which could be used as a day-room for convalescent patients and as a waiting-room for the friends of patients who may be required to remain within the hospital precincts in cases of serious illness.

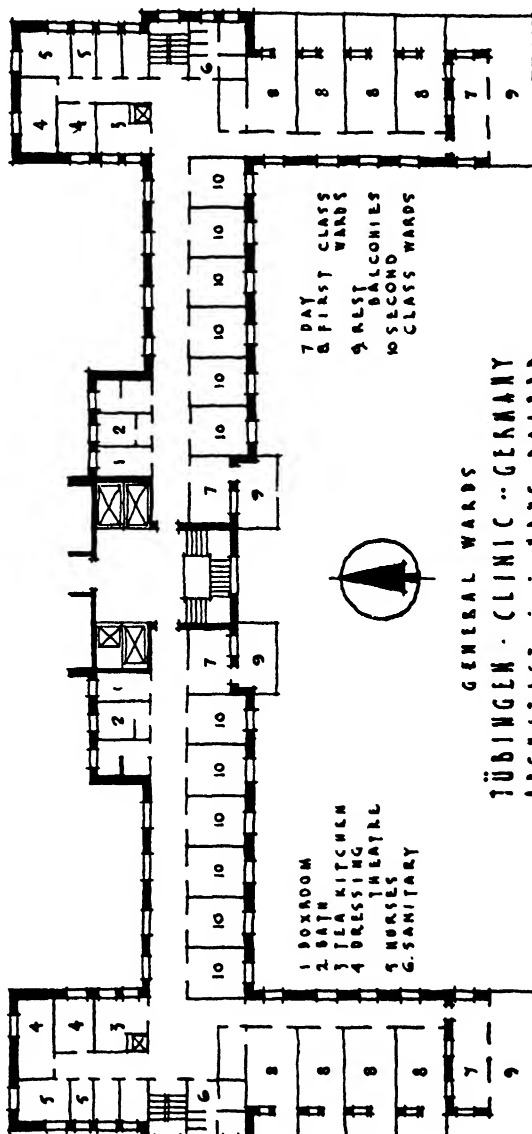


Fig. 87.

Ward Office. The location of the ward office is highly variable, depending somewhat on the facilities it is desired to provide. It varies from simply a desk, chart rack, and medicine cabinet in the corridor—or better, recessed into the corridor wall—to a fairly large room providing these facilities and in addition a rest-room and dressing-room for special duty nurses. Most authorities agree that it should be so arranged that the sister from her desk should have visual control of her entire corridor, should be at or near the entrance to her area, and in a place sufficiently prominent to be easily found by visitors and strangers as well as personnel. In America the use of a floor secretary has become increasingly popular, and if such service is desired her location should be approximately that described for the sister under whom she works. But even this does not eliminate the need for locating the sister as previously described.

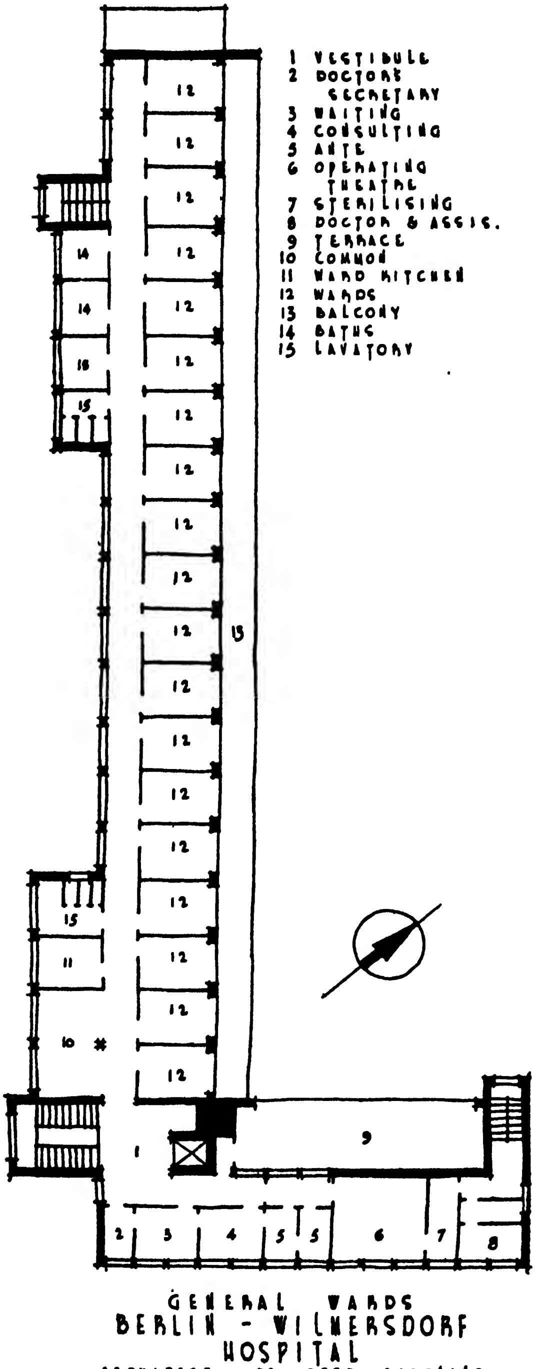


FIG. 88.

The question whether the sister in charge of the unit should have a separate room in which to keep her papers and do her writing, etc., is one on which there is a difference of opinion in Britain. Some of the witnesses to The Report emphatically declared that this sister should have her writing-table in the main ward so that she could supervise the patients and the work of the ward as continuously as possible. However, it was found that there is need for a ward office, which can be used by the sister and doctors for records, correspondence, etc., and which is also available for consultations and interviews.

If not provided in the duty-room, a useful combination fitting for this office consists of a poison cupboard in the top, with a door-operated switch light, a rack for charts in the centre and a store cupboard with movable shelves at the bottom. In use it is found that a space for inserting the names of patients over the chart is helpful.

Ward Kitchen. This is intended only for the service of meals and the preparation of light meals, tea, etc. If possible, it is desirable that all ward kitchens should have direct lift communication with the central kitchen.

A room with an area of about 200 sq. ft. is sufficient, containing a properly ventilated larder, although this has been partially replaced in some hospitals by the use of a 6 to 9 cu. ft. capacity refrigerator. The other necessary equipment is a sink with draining-boards, a gas or electric stove (with a toaster) for simple cooking—a hood having an extract ventilator should be provided over the cooker—and cupboards for china

PLATE XXXI. Ward Kitchen
Hillingdon Hospital

PLATE XXXII. Examination Room
Hospital Centre, Birmingham

[*To face page 180*

PLATE XXXIII. Sluice Room
Hospital Centre, Birmingham

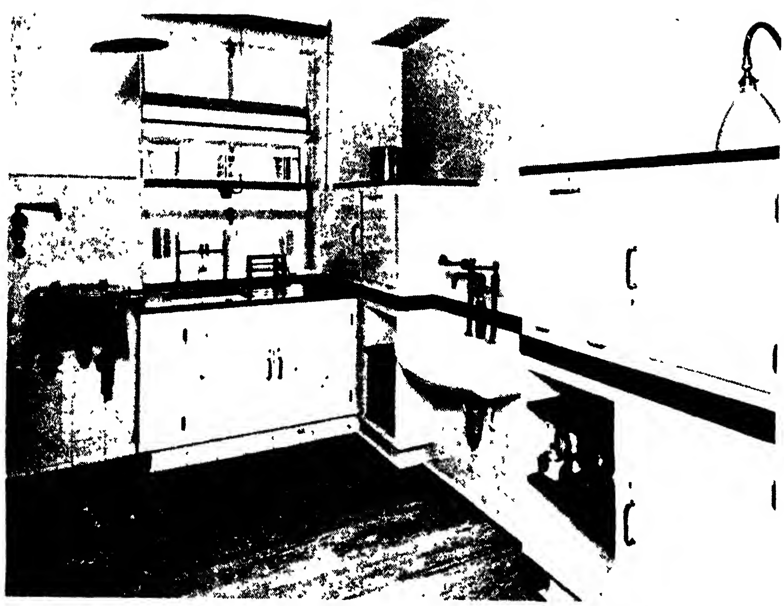


PLATE XXXIV. Duty Room
Great Ormond Street Hospital for Children, London

To face page 181]

(both patients' and nurses'); and also a cupboard, divided into separate compartments, for patients' eggs.

Duty-room. The Report recommends that this be quite separate from the ward office and ward kitchen, and is to be used for sterilisation and various other processes in connection with the medical and nursing work of the ward. If so planned, observation of the ward can be secured by the provision of a window or a glazed screen. In this room a full complement of trolleys being kept always in readiness for constant use.

Space should be available for examination, treatment, and dressing trolleys, and the room should be fitted with combined sinks, lavatory basin, cupboards, and possibly sterilisers. An important fitting is the drug cupboard with door-operated light, which, besides drugs, usually contains many other medical and surgical items. The capacity

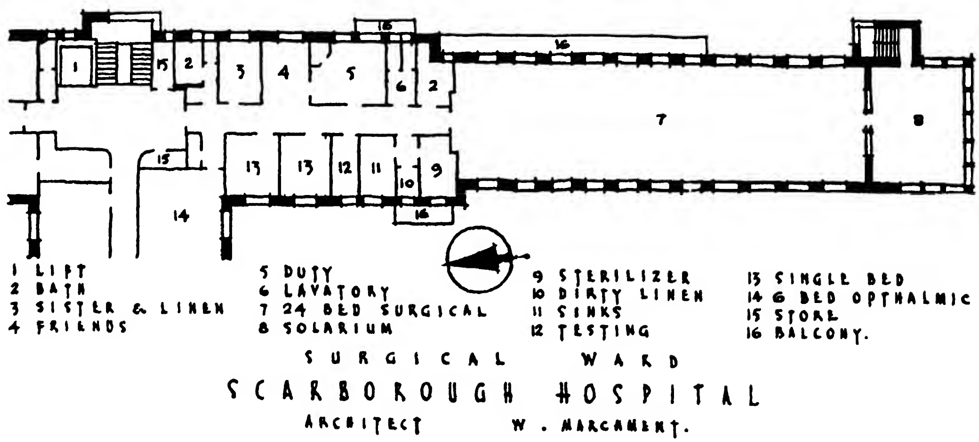


FIG. 89.

should be carefully considered with relation to the size and nature of the ward unit it is to serve. In the section containing medicines in constant use, it is a good plan to put narrow shelves to contain only one row of bottles; this can be supplemented by racks on the inside of the doors, thus simplifying the nurses search for the right bottle. The poison cupboard should be fitted with a red light to indicate when the doors are unlocked. In some opinions this cupboard should be situated in the branch corridor or in the ward office.

In America this arrangement is rapidly giving way to the so-called central supply service in which all dressings, equipment, and trays for diagnostic, treatment, or dressing purposes are prepared and kept in readiness at a central supply room and despatched to the nursing unit where and as requested for immediate use. There is, however, a modification of the central supply service system in which each ward is supplied each morning with an estimated day's supply of the most used items from the central supply service. In such cases there must be storage arrangements in the duty-room. Only the

unusual or emergency supplies will then be sent from the central supply room on the immediate order as needed.

Sluice-room also Testing. The sluice-room, also referred to as the utility or sink-room, being the most used facility has received the most extended study, both as to location and as to equipment. It should be placed adjoining but not opening directly out of the

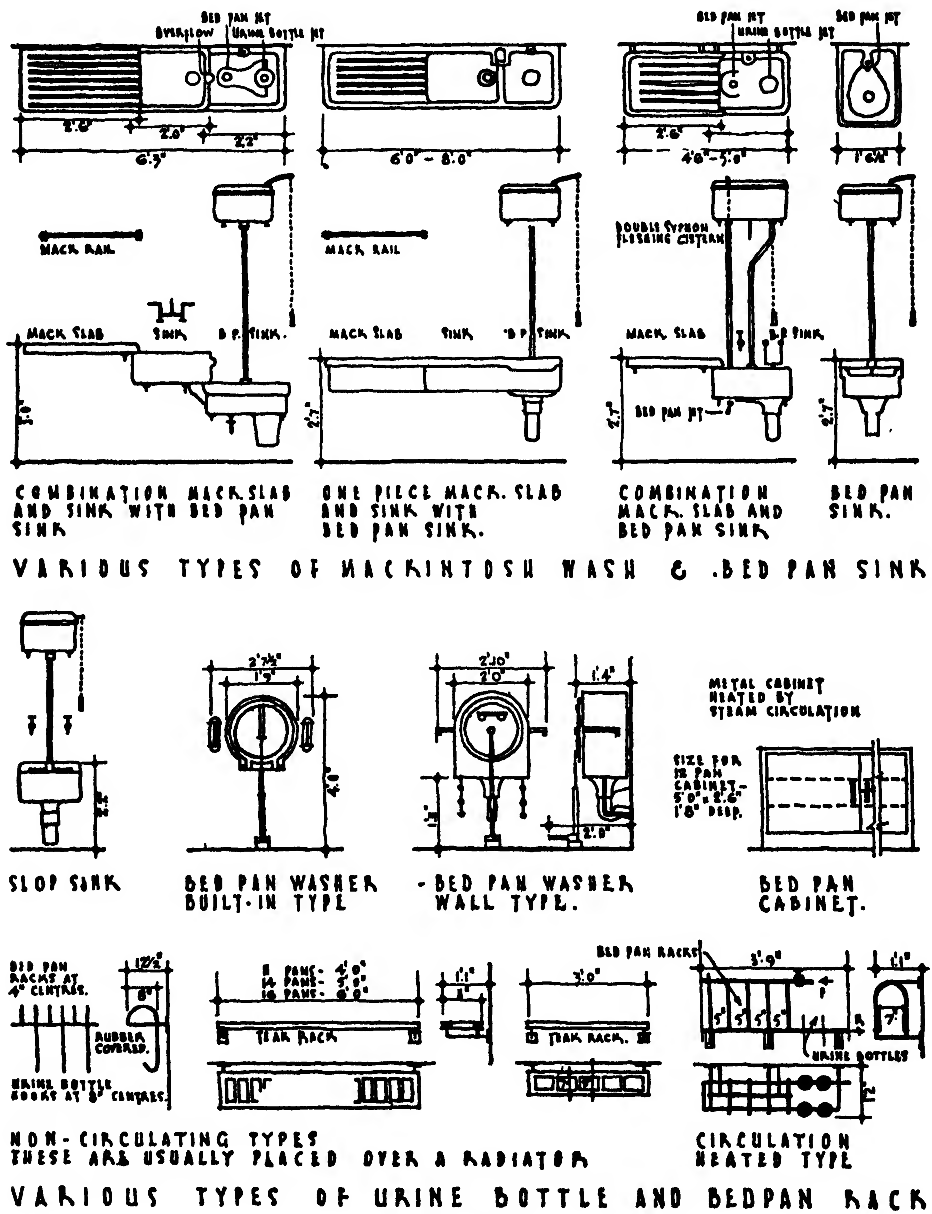
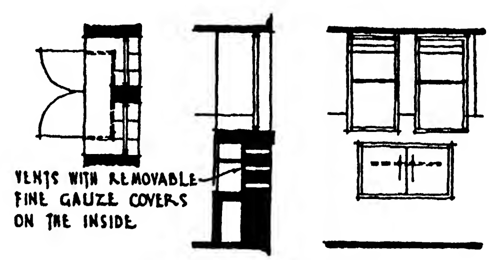


FIG. 90.

main ward, and contains an area of 100 sq. ft. At one time it was usual to provide a ventilated cut-off lobby between the sluice-room and ward or corridor, but to-day with improved fittings and plumbing this is generally considered unnecessary.

A separate test-room is sometimes provided, but if only such simple testing as the routine chemical analysis of urine is done within the ward unit, a recess may be sufficient or a specimen cupboard placed under the window. If a separate room is provided, an area of about 80 sq. ft. is required and it should be well lighted.

There is obvious inconvenience in the long carrying distance for bed-pans from the far end of a long ward to a sluice in the ancillary section. To meet this, The Report recommends that a second sluice-room may be provided in the case of a ward of twenty beds and upwards, either at the end of the ward or at the side near the centre, in a projecting annexe. There are objections to the latter position when a ward has a north to south axis and the transverse arrangement of beds, as it almost necessarily involves the omission of a bed or the addition of 5′ to 6′ to the length of the ward (see Fig. 83) otherwise the beds become cramped. If a subsidiary annexe is provided in the ward as suggested, provision for bed-pan washing and storage, together with that for urine testing, is suggested. An instrument and bowl steriliser and means of obtaining hot water are also desirable.



SPECIMEN CUPBOARD

FIG. 91.

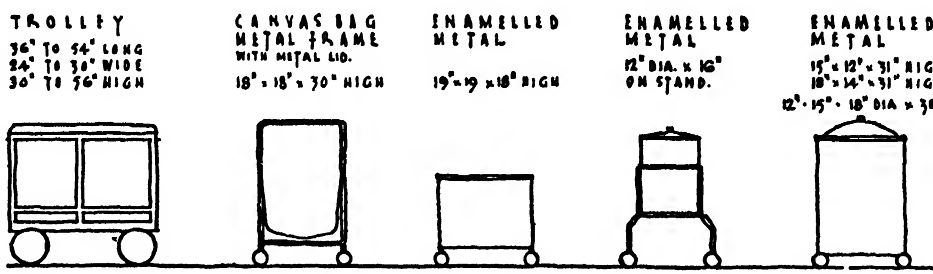
In addition to or alternative to the bed-pan washer will be fitted the bed-pan sink, a large scalding sink and fluted fireclay drainer placed sufficiently high to make stooping unnecessary. The large sink with the fluted drainer will be used for scrubbing and cleaning mackintoshes, and a mackintosh rack fixed over the drainer will be required for drying them. To complete the room, a work bench, a towel rail, and a heated bed-pan rack or cabinet and urine bottle racks will be required all being heated by hot water circulation or steam (see Fig. 90).

A great improvement has been made in recent years in the type of bed-pan washer; previously it was an open slop sink with an upcast jet at the bottom. The latest pattern, copied from America, is a closed compartment something like the old tip-up cabin found in railway carriages (see Fig. 90 and Plate XXXIII). By the introduction of this bed-pan washing and sterilising cabinet—of which more than one model is available—the particularly unpleasant method of cleansing these articles need continue no longer. The nursing staff can testify to their appreciation where they have been successfully employed. It is claimed that the bed-pan can also be sterilised by the introduction of a steam jet, but this is very impractical as sterilisation takes 20 minutes, during which time the bed-pan washer cannot be used. Sterilisation should be done in separate apparatus and electricity is the solution if steam is not available. Cabinet bed-pan washers have come to stay, but when a ward is very busy one washer

cannot always get through the work, and therefore an ordinary bed-pan sink might be supplied in addition to the washer.

Under the window of the testing recess or room, a tile-lined cupboard with double doors will be required for the temporary storage of faeces, sputa, blood, urine, etc., awaiting examination (see Fig. 91). Externally, the cupboard should be ventilated by constructing the wall of air brick vents with removable fine gauze covers fitted inside, size 4′ by 2′ 6″ deep. A bench for microscopic work, covered with vitrolite as the chemicals in use stain wood badly; a small sink, and cupboards with shelves for instruments, test and stock bottles, with an airtight instrument compartment, complete the testing requirements.

An open-air or well ventilated balcony—protected by glazed screens if necessary—for the disposition and temporary storage of soiled linen, etc., can be provided adjoining; it is more serviceable if planned between sluice-room and ward kitchen, as it can also be used for refuse bins. From the balcony a hand-power or electric lift takes the



TYPES OF SOILED LINEN AND DRESSING BINS

Fig. 92.

bins direct to the ground level, without passing through the building. In multi-storeyed ward units chutes could be provided, one for soiled linen and the other for refuse. Fig. 92 gives details of standard soiled linen and dressing bins.

Somewhere bowls for the washing of patients must be neatly stored. Shelves in a recess will do, but a cupboard that provides provision for the storage of cloths for covering bed-pans is more desirable.

In America, one of the most recent ideas, in various types of winged construction, is to place the sluice-room (where it is called "utility") at the junction of the two contiguous bed areas at right angles to each other with entrances on the two corridors as near the centre of each of the wings as is practicable. There is also a growing tendency to so arrange it as to divide it into at least a theoretical "dirty" section and "clean" section. In some instances it has been thought wise to include in the clean side a medicine cabinet and medicine sink, storage for flowers, a small refrigerator and even cupboard for examination, treatment, and dressing trays. The tendency is to use a refrigerator of the domestic mechanical type. Similarly recent studies indicate a preference for autoclave steriliser, utensil type, rather than the formerly used boiling steriliser. Some

authorities advocate the building of a bed-pan service room separate from the utility-room, as this is the one service that involves the most travel and which for esthetic reasons can well be separated from the other service utility functions.

Sterilising-room. In some hospitals and in special wards a small sterilising-room is provided, which should be conveniently placed in relation to the sluice-room and test-room. This would then be additional to the duty-room.

A small room is required; two or three small sterilisers are usually provided, one for instruments and the other for bowls, etc., together with a small sink. Over each battery of sterilisers should be a wired plate-glass hood, from which steam must be mechanically extracted; to provide an opening in the outer wall in the hope that the steam will escape through it naturally is quite useless. Another small but essential item is the provision of a gutter under the bottom edge of each hood to receive the condensation water and save it from dripping on the nurses.

Patients' Lavatory and W.Cs. The patients' lavatory should consist of two closets and two lavatory basins. The W.Cs. should be entered from the lavatory, thereby forming a lobby between the branch corridor, and should be at least 5′ long and 2′ 9″ wide, with the door hung to open outwards to facilitate the removal of any patient who may collapse.

An important point, inclined to be overlooked, is that lavatories should be heated; in fact, all parts of the ward unit should be kept at the same temperature in order to eliminate sudden temperature changes and draughts.

Natural ventilation through windows is important. The peculiarly British habit of having permanent "vents" in walls of lavatories should be abolished. These almost invariably let air in instead of drawing it out, make satisfactory heating and ventilation more difficult, and in no way contribute to health.

Staff Lavatory and W.C. In conjunction with a closet, a locker for each nurse, and two lavatory basins should be provided.

This lavatory should be quite separate from that of the patients.

Bathrooms. In a unit of thirty beds there are generally two baths, and in some modern hospitals a feature is the substitution of one bath by a shower bath; this leads to economy in water consumption. Baths cannot, of course, be done away with entirely but of those patients who are not blanket-bathed, a high percentage would be strong enough to cope with a vigorous shower bath.

The baths should be built-in and continuous with the floor and wall finish, and should be so placed as to allow a nurse to stand on either side of it to support and wash the patient, and should be placed with the head facing a window. There should be sufficient space on at least one side for manoeuvring a wheel chair. To facilitate quick filling and emptying 1″ services and 2″ wastes should be installed. The installation of baths has long been a subject of controversy in hospitals from the

point of view of the more or less handicapped patient, the bath might best be sunk into the floor. However, this is hazardous and makes cleaning difficult. Even a normal installation height is objected to because it requires the maid to get on her knees. To arrange a bath for ease in assisting the patient and for cleaning, a height of about 3′ would be required, but that would be very difficult for the patient to negotiate. Fig. 93 represents what is regarded as a reasonable compromise. The bath is raised two steps high. This seems reasonable for the patient to negotiate, for the nurse who must help the patient, and finally for cleaning up.

Treatment or Examination Rooms. Treatments and dressings are commonly carried out at the bedside in one and two bed wards, the equipment being carried on a trolley. If patients are in large wards, some staffs prefer to have at least the major post-surgical treatments given in a separate treatment room, as it is more convenient for the physician, all treatment is easily available, and there is less disturbance to other patients. With the tendency toward smaller bed units and better surgery requiring less elaborate after-treatments, there is a definite tendency toward omission of treatment rooms. They should not, however, be omitted without careful consideration, as they are often useful for purposes other than treatments and dressings.

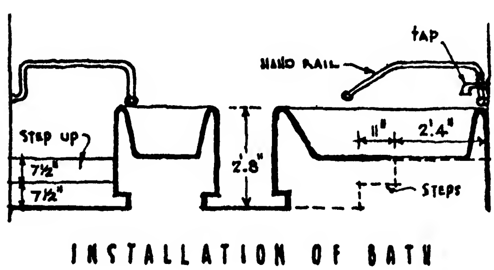


Fig. 93.

An area of 300 sq. ft. is needed only where a ward class of medical students is held. In most hospitals, if needed at all, it can be much smaller. This unit is not recommended in The Report. (See Plate XXXII.)

Linen-room. The space necessary for linen varies according to the method of linen control. In case the linen service is based on the unit exchange system all reserve is kept in the central linen supply room, and space need be provided in the ward unit only for one day's quota of clean linen plus a small reserve of from 10 to 20 per cent. of the daily quota. In decentralised linen service, provisions may be necessary for two to three times the daily ward complement of linen plus extra pillows, blankets, and other storage items.

There is general agreement in this country that each ward unit should have its own complete working stock of linen, for which the sister is responsible. Some provision for patients' clothes may be required in the ward unit, but it need not be extensive, and lockers should suffice (see also Chapter 8: Patients' Clothing).

A room with an area of 70 sq. ft. ventilated at top and bottom should be provided for the ward linen. Heating pipes should be carried around the floor as a necessary provision for drying and airing. Slatted shelving 1′ 10″ wide is required and a flap-table for the sister's use. Arrangements must be made in either this room or in a separate room for warming blankets and towelling used for bed baths. The latter can be overcome by providing ample hot towel rails in the bathroom.

General Store. This is required for miscellaneous articles, some of them bulky, such as bed-rests, cradles, splints, water beds, air-cushions, etc. This is a very necessary provision, as it is not uncommon to find hospital wards embarrassed by the lack of storage accommodation, resulting in various articles being stored in bathrooms and other unsuitable places.

If no accommodation is provided in the linen-room, numbered lockers should be provided for patients' own clothing.

Cleaners' Room. One room (H. M. C.) for every 100′ of corridor is the minimum for practical convenience. It can normally be in the branch corridor to the wards or grouped near some lavatories, and must be well ventilated.

An area of about 40 sq. ft. should be provided and contain a heavy sink with protected edges at a suitable level for filling buckets, hot and cold water, a slop sink, racks for brooms, buckets and mops, and storage for necessary articles such as soap, dusters, and polishes, etc.

ACCESSORIES TO WARD UNIT

Windows. Windows generally will be reviewed in Chapter 36 The movement of air is almost as important a factor as sunlight, and in wards the movement of air does not mean draughts, which are isolated rushes of cold air in an otherwise warm room. The movement of air has had a great boost, and the effect has been the designing of new types of window with 100 per cent. opening capacity. The provision of large windows admitting plenty of daylight is a valuable aid in killing bacteria on the floor and elsewhere in a ward. The interposition of glass does not materially prevent its effect, which occurs even under winter conditions in this country.

Except for mental villas, it can be said that there are now two types of windows used in wards (see Fig. 94):

a one in which the upper fourth is horizontally centre-hung, the bottom fourth is bottom-hung to open inwards, and the centre half is side-hung to open outwards; every part of the window can be cleaned from the inside, 50 per cent. can be opened even when wind and rain are driving against it, and in fine weather the unobstructed ultra-violet rays can be let in through one-half of the window area;

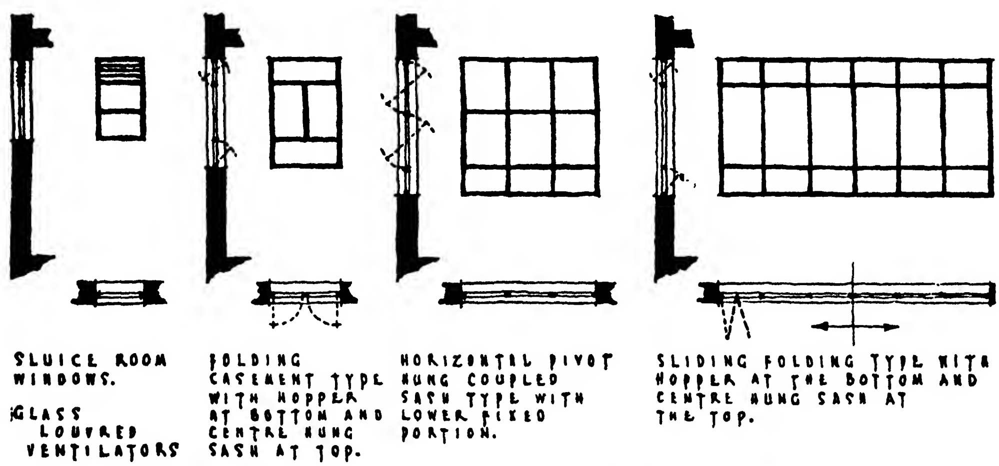
b as an alternative to (*a*) for use with the longitudinal bed layout is the sliding folding type. Windows are attractive in this form, give a sense of space, and the large free openings are a delight in fine weather. The sliding folding sashes can be made with upper portion centre-hung and lower portion centre-hung or bottom-hung. The bottom portion is necessary to prevent dust blowing into the ward from the outside sill. With this type of window there may be a case for a separate series of ventilating windows at or near ceiling level.

It will be noted that in (*a*) the bottom fourth is hung to open inwards, i.e. as

a "hopper." Hoppers are used to throw the incoming air up over the heads of the patients, but they must not be used near the ceiling or a severe down-draught will result. With type (*b*) window, the ward is greatly enhanced in appearance if it is associated with a suitable curtain treatment, such as casement cloth, obtainable in a variety of colours and readily adaptable for screening patients from excessive light and from the direct rays of the sun. These curtains can easily be removed and replaced when they require to be washed.

In mental hospitals double-hung sash windows are normally used. These are referred to in Chapter 36.

The diagrammatic sketches (see Fig. 67) indicate by the contour lines the number of



ALTERNATIVE TYPES OF WARD WINDOWS

FIG. 94.

possible hours of sunshine between the two types of windows used respectively in the transverse and horizontal layouts.

The window sill should be 2′ 6″ from the floor level, but this distance may have to be increased on upper floors in order to lessen the risk of accidents. The window should extend to within 3″ to 6″ of the ceiling; this distance being provided owing to the possibility of damage to the ceiling surfaces by rain coming through the fan-light. If casement windows are provided to verandas, they should be not less than 3′ 6″ in width and should open outwards. The height of sill will be determined by the size of radiators (if used), but it must be remembered that it is desirable that the height permits the patients to obtain some view whilst lying in bed. The friction stay type of window fastening should be used where this is applicable.

The window sills should be either of polished hardwood or tile, the latter being preferable in order that they can be easily washed. As an alternative, they can be of metal (see Chapter 36).

Blinds. Window blinds are a necessity for coolness and shade, to prevent glare, to save eyestrain, and to induce sleep. A blind that may be raised from the sill to any desired height, including complete coverage of the window, is desirable.

Unduly strong sunlight can be excluded by roller blinds fixed at sill level and extending upwards. This practice also ensures easy removal of dust from the blinds and rollers, and the blinds when pulled partly up give privacy when this is required. When roller blinds have top fixing, they should be fixed a few inches from the wall face, with independent cover for roller, to allow the hot air that gathers under the blind to escape upwards. Cooling in summer is largely a matter of circulation.

A blind known as the "Outlook" is manufactured which gives privacy and yet allows excellent ventilation, gives perfect shade from the sun and yet permits unrestricted outlook.

Doors. Doors of a type which do not entail excessive noise in use should be selected; it is usual for a silent self-closing device to be fitted to prevent noise from slamming. A small point but often overlooked, especially in regard to cupboard doors, is the avoidance of noisy door-catches. This subject is discussed in more detail in Chapter 36.

The doors themselves as well as the frames should be of the flush type in order to give a minimum opportunity for lodgement of dust, bacteria, etc. Frames can be either metal or timber. Architraves may be dispensed with, and, owing to non-shrinkage of seasoned materials, a good joint can be made with plastering and adhesive tape.

It is important that the doors of wards should be constructed so that beds can be easily wheeled in and out (minimum 3′ 9″). For this purpose it is desirable that double doors 4′ wide be provided to small wards and the principle doors into the large wards should be 4′ 6″ wide swing doors, for they are more satisfactory when handling beds or stretchers. The clear opening of all other doors should be ample for their use, i.e. 3′ 3″ for ward kitchens; 2′ 9″ for bathrooms, sluices, etc. Glazed doors are unnecessary unless of the swing type. Door furniture which does not require polishing should be used.

Screens. When the beds are placed parallel to the long walls (longitudinal layout) they are separated by glazed screens. The provision of these screens to divide the ward into groups of beds tends to dissipate the "institutional atmosphere" of a long ward and facilitates convenient classification of patients.

These screens can be constructed either

a with plated metal panels below polished glass, and can be fitted with cantilevered brackets supporting reinforced curtain rails; they are fixed 6″ away from the wall and have a space of 12″ between bottom rail and floor; special provision is made in the centre style for lighting wires, wireless, etc., to each bed, and for an oxygen supply and vacuum to some beds;

b the London County Council are providing screens with a plaster dado and frieze, with the glazed section of such height as is sufficient for adequate observation. In other cases, the partitions are no more than 7′ in height with the upper portion glazed for the purpose of observation.

Curtains. Where it is desired to separate particular beds from the rest of the ward there are several methods which can be adopted, for example the use of portable screens or curtains suspended from an overhead rail. The latter practice is preferred by most authorities as the patient is thus enabled to screen himself when he so desires for purposes of privacy, and it dispenses with the labour involved in wheeling the screens about the ward.

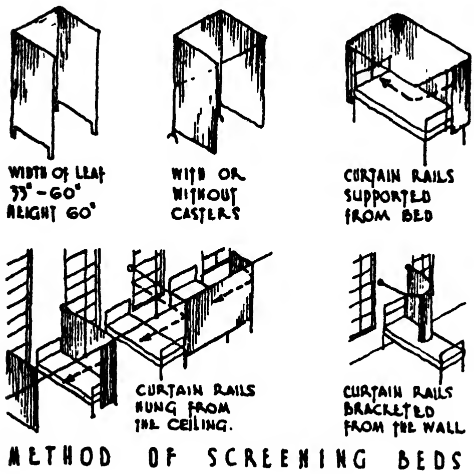


FIG. 95.

The alternative methods (see Fig. 95) are—

a curtain rails bracketted from wall to single bed
b curtain rails hung from ceiling along front of bed and between each bed
c curtain rails supported from bed
d screens with or without casters—height 5′ 6″ and width 2′ 9″ to 5′.

With the longitudinal bed layout, each person lies sideways to the light, and with a central corridor a continuous curtain rail can be fixed.

Portable curtains can be stored most conveniently in the ward, and for this purpose there should be a space of 3′ between the end beds and the walls.

Call System. This system is discussed in detail in Chapter 36. When the push-button is operated by the patient, it indicates a light over the patient's bed, above the ward door—on its corridor side—and in either the ward office, duty-room, or ward kitchen, whichever is considered the nurses' station. It is desirable to provide a call service to each bed—as in single-bed wards—but on the grounds of economy the individual light over each bed can be used by the patient to call a nurse at night.

These lights may be secured in a variety of modifications up to a master board with a timing mechanism located in the central administrative offices with a record of each call and the time elapsing before its answer.

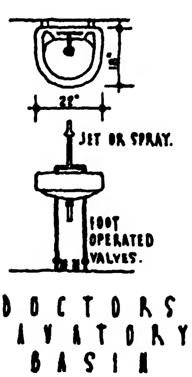


FIG. 96.

Wireless. Wireless consisting of plug-in ear-phones is required above the beds of all patients. Provision is made in central style of screens, for use with the longitudinal layout.

Loud speakers may be provided in some wards occupied by ambulant patients and in some children's wards, but they are normally limited to day-rooms.

Wash-basins. These should be installed in all wards for the use of the staff. The number and situation of these will depend on the size and shape of the ward. See Fig. 96.

Artificial Lighting. The ideal in lighting for the wards has not yet been found, but it is generally agreed that it should not include any ceiling light nor a wall bracket light so placed as to face the recumbent patient with any glare or direct rays.

For general lighting in the single ward there is much to be said in favour of the conventional floor type standard lamp so designed that a part of its light is directed to the ceiling for general illumination. There is general agreement on the need of a light either placed on the wall or attached to the head of the bed and so designed that it can be used by the recumbent or half sitting patient as a reading light, but will not shine directly in his face. The most satisfactory method of lighting the large wards is to install a number of centre lights 7′ 6″ from the floor and a bracket light at 6′ 6″ over each bed or between two beds. The centre lights to have bell-shaped globes and the bracket light to have opaque shades in order to increase the downward deflection. With a bracket between each bed an opal glass shade is desirable owing to the cut-off produced by an opaque shade. Each square foot of floor space will require approximately 3 watts.

In addition to the above, provision should be made for night inspections by a point for a hand lamp, with daylight lamp at floor level adjoining alternative beds, for a counterweight fitting over the nurse's table, and an obscured night-light reflecting on to the ceiling. As an alternative to the ceiling light a more acceptable method of lighting is by fixtures 1′ 6″ from the floor, usually built flush with the wall to prevent damage. To direct the light to the floor and to prevent glare, the fixtures are equipped with plastic sheet which is tilted, with its top edge flush with the wall, its bottom edge recessed (see Fig. 97).

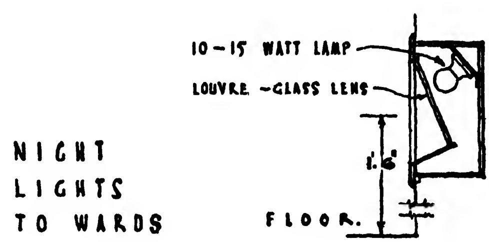


FIG. 97.

There are no special requirements for the lighting of the ancillary rooms.

Heating. The alternative methods are:

a	steam	*e*	plenum
b	hot-water radiators	*f*	electric radiators
c	hot-water pipes	*g*	electric tubular heaters
d	hot-water panels	*h*	electric panels.

In the design of the ward the heating must be studied as one of the most important factors, and it is well to remember that as far as possible the heating should be located away from the patient's head. This latter point is another argument in favour of the longitudinal layout.

The temperature required in the wards and ancillary rooms is 60 deg. to 65 deg. F. The adoption of the longitudinal layout will slightly increase the cost of maintaining the necessary minimum temperature, to compensate the heat losses due to large expanse of glass area.

The alternative methods of heating and air changes will be discussed in Chapter 37, but gas and coal fires can be used for supplementary heating if required. They should be restricted to day-rooms, or similar, and not used in the wards themselves.

In all systems of heating and ventilation it is important to arrange the air-flow so as to carry dust and infective particles away from the airflow, and to carry dust and infective particles away from the patients, rather than towards them. When other conditions permit, this is most easily done by a plenum system, bringing warm air in near the ceilings, and exhausting it at floor level.

Power Points. The supply of electricity for power purposes is required for electro-medical apparatus, diathermy, radiant heat baths, and portable X-ray plant, the number of power points for electro-medical points depending upon the size of wards. For standard long wards it is customary to provide four 15-amp. points.

Bedside Locker. Although the patient is the focal point of all services, there is little that can be done in connection with his immediate personal comfort. There is his bedside locker, an essential and constant companion, generally of hardwood, but far more sanitary in stove-enamelled steel. With clean lines and stainless steel top one has a good, suitable, and sanitary article.

FINISHINGS

Too much care cannot be given to the general colour scheme for the walls and finishings, not only of the wards, but all the apartments of the hospital. Patients and staff, whether or not accustomed to tasteful furniture and decoration in their own homes, should not be subjected to ugly and inartistic wards and rooms in hospitals. A cheerful, warm atmosphere should be aimed at.

All finishings selected should be smooth and capable of being cleaned easily, and all shelving, whether in cupboards or on walls, should be fixed ½″ to 1″ clear of the wall at the back to facilitate cleaning.

Every effort must be made to avoid obstruction to the floor surface, cantilever brackets being used on every possible occasion. This applies to such things as small gas-cookers, refrigerators, sinks, shelving, wall tables, and so on.

Dust must be outlawed. Wards should be designed to prevent dust accumulation. Walls should be smooth with rounded corners; no ledges, even at the windows and doors; furniture should be built in with movable pieces reduced to a minimum. Dry dusting and dry sweeping of floors should be prohibited. The most effective method of keeping down dust from floors is the use of oil on floors of wood or linoleum. For floors of terrazzo, cement or asphalt, oiling is unsuitable, but wet sweeping or sweeping with sawdust moistened with calcium chloride is helpful. Vacuum sweeping is better than dry dusting, although large numbers of organisms pass through the walls of the dust bag of the ordinary portable domestic sweeper; hence vacuum sweeping into a centralised piping system is preferable.

Ward Floors. The Report states that the best finish for the floors of wards is hardwood, but a satisfactory substitute at greatly reduced cost is thick linoleum (which should have a life of about 20 years), or other similar covering, laid direct on cement screeding.

Rubber is a relatively expensive form of floor covering and this has limited its use in hospitals. Thin rubber has not proved satisfactory, but when used of sufficient thickness, say not less than five-sixteenths of an inch, rubber provides a quiet and suitable floor. Other alternative materials which can be used are parquet, cork composition, terrazzo, etc., with alternative methods such as a combination of wood and rubber or terrazzo.

At junction of walls and floors, a triangular hardwood fillet or low skirting may be used. Curved angles in woodwork are delightful, but they are expensive.

The question of floors for open-air wards is not so easy. Large tiles and granolithic have proved the most satisfactory.

The policy of keeping floors over polished is to be depreciated, for not only is this a

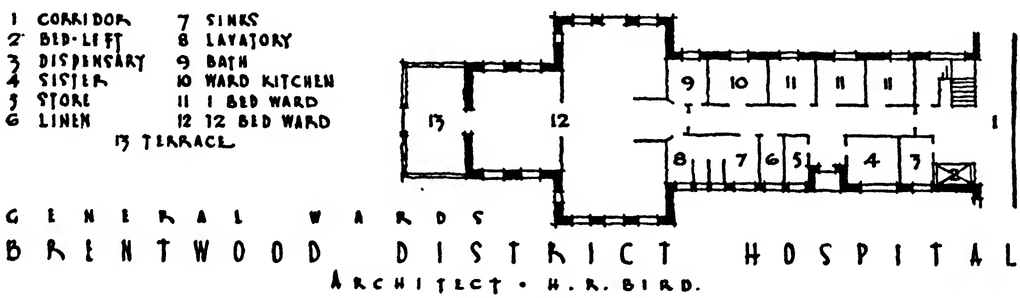


FIG. 98.

waste of labour and materials, but it is a danger to patients and even staff, who are apt to slip on them.

Ward Walls and Ceilings. With a view to lessening noise in wards, The Report recommends ordinary plaster for walls, except to window reveals, door jambs, and other parts up to 4′ 6″ high, liable to damage; these should be of hard plaster. It is interesting to note that ordinary plaster, presumably distempered, instead of hard painted plaster is recommended for accoustic reasons. This represents a notable departure from tradition.

The Report states it is not convinced that rounded internal angles at wall junctions are necessary.

Other alternative materials which can be used are terrazzo or tile, but owing to their expense these are seldom used, although a limited amount of tiling with picture tiles is justified in children's wards.

The following methods can be used to protect walls from bed markings:

- *a* raised margin on floor or chamfered designed skirting
- *b* protecting rail or hot-water pipe.

The walls of the latest wards at St. Bartholomew's Hospital, London, are finished in Keene's cement and enamelled. The floors, which are of teak, have a margin of terrazzo, the margin being raised to prevent beds being pushed against walls.

Ceilings should be of ordinary plaster, kept light in colour to reflect maximum daylight.

Ancillary Room Floors. Owing to its relatively high cost, the use of terrazzo should be restricted as far as possible to the floors of specific rooms, i.e. sluice-rooms, etc. Other floors requiring frequent washing should, with a view to economy, be paved with granolithic, which can be coloured successfully if the natural colour is considered objectionable. In cases where the use of a less absorbent and jointless material is desired asphalt is available.

Another alternative, and justified for the floors of, say, ward kitchens, is first-grade quarry tiles.

Ancillary Room Walls and Ceilings. The restriction on the use of terrazzo for floors applies more so to walls, but should be used in rooms such as the sluice-room. An alternative for these rooms is a glazed tiled dado 4′ 6″ high which is a particularly good form of wall finishing. Its adoption or rejection depends mainly on cost, but once installed, the maintenance cost is negligible. The economical alternative to the foregoing is hard plaster with three coats of paint.

At junctions of walls and floors finished in terrazzo or similar coved angles of the same material should be provided.

In the latest wing of St. Bartholomew's Hospital, London, the walls are finished in Keene's cement with an enamel finish, with the exception of the dado in certain rooms, such as bathrooms, sluice-rooms, and lavatories, the dado being of light coloured terrazzo with a black line at the top.

Again ceilings should be kept light in colour to reflect maximum daylight.

19

The Central Sterilising

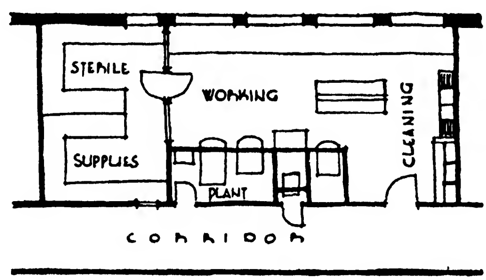
A SUITE OF ROOMS may be provided in a central position in the hospital for the preparation and sterilising of dressings in bulk for the whole of the various units; the dressings and gloves are brought to the theatre in sterilised air-tight drums whenever they are wanted.

ACCOMMODATION

As the suite of rooms is usually under the control of the engineering staff, the accommodation must be planned in close relation to the central power-house.

The size of the room or rooms required will vary according to the size and class of the hospital which it has to serve. It is usual to provide at least two sections, one for unsterilised dressings and the other from which dressings, etc., are taken from the sterilising apparatus and placed into the sterilised air-tight drums. See Fig. 99 for a typical layout.

Separate access to the pipe services supplying these two sections must be provided.



CENTRAL STERILISING
TYPICAL LAYOUT

FIG. 99.

SERVICES

Sterilisation may be by steam, gas, or electricity, but where steam is available it is the most satisfactory method. Gas is unsuitable if anaesthetics are stored adjacent owing to the danger of explosions. Where electricity or gas is the heating agent the filling of bowl, crockery, and instrument sterilisers, should be from a hot-water service and not from a cold-water supply.

20

The Central Supply Service

The central supply service is a relatively new development in hospital operation, but its convenience, economy, and better service to the patient and to the staff have added to its popularity in the American hospitals.

This service prepares all supplies for use in the wards, sterilisers such as require it, and assembles them in standard complete ready-for-use units for delivery to the wards as needed. The economy and convenience of the service lies in the fact that with specially trained personnel and a single working space it is economical to equip it with labour-saving devices and to establish standards not possible under the old system of each ward preparing its own supplies and equipment.

The consolidation in one place of all the steps in the cleaning, inspection, and repair of used equipment, the preparation and storage of new supplies, and the assembly of prepared sets of equipment and supplies ready for immediate delivery and use, permits these operations to be carried out in batches rather than piecemeal, and saves both time and supplies and develops special and more effective skill of the personnel.

PLANNING

This service should be so located as to facilitate prompt delivery to all parts of the hospital. The space is functionally divided into three quite distinct areas:

- *a* receipt of new goods and the receipt, cleaning, and reconditioning of used equipment;
- *b* the preparation and sterilisation of supplies and utensils and the assembly of sets;
- *c* the storage of supplies, equipment and assembled sets ready for delivery and use.

ACCOMMODATION

It is entirely practicable to carry on the first two of these activities in one room, but the storage should be in a separate room which can be kept under close control. The space required for such service varies with the completeness of the services which are to be included. In hospitals of two hundred beds or more it will usually vary between 1½ and 2½ sq. ft. of floor area per bed to be served. In smaller hospitals it will require a

minimum of 200 sq. ft. unless consolidated with the work of the surgical suite or the central stores of the hospitals.

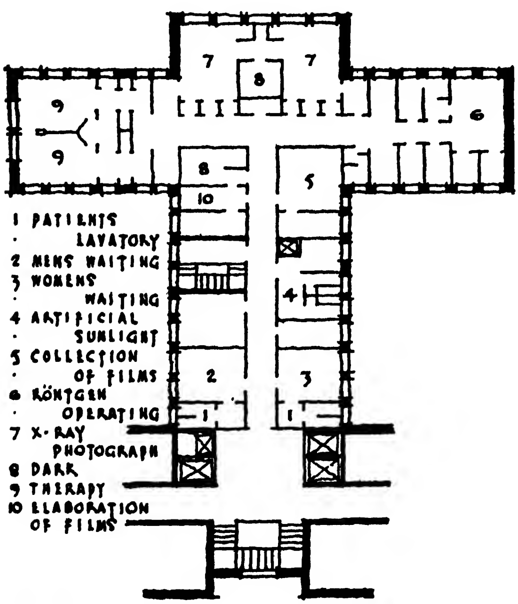
BLOOD UNIT

The rapid increase in the use of blood, either as whole blood or as plasma, has made the availability of such service to the community a "must." In hospitals of less than two hundred beds it will generally be preferable to depend upon some central service for the processing required in the preparations of plasma for storage. But in the larger hospital it is well to supply relatively complete facilities, except perhaps for the dehydration of plasma, and this must include a bleeding room and processing room. The testing can be carried out in the laboratory. Storage should be provided in the blood unit, equipped with a refrigerator of adequate capacity and temperature control.

21

The Radio-diagnostic Department

No hospital can work without X-ray facilities. A modern radio-diagnostic department, even in a small hospital, demands accommodation built for the purpose. The important fact to bear in mind is this—the use of X-ray has grown and is growing so rapidly that this department has become a primary rather than a secondary factor in hospital design. The day is gone when X-ray could be treated as an afterthought, to be tucked into any odd space otherwise unoccupied. There are many reasons for this shift of emphasis. For one thing, in routine diagnosis fluoroscopic and radio-graphic X-ray is to-day the rule rather than the exception. X-ray therapeutic applications, both superficial and deep (as an irradiation treatment of cancer), have grown apace. The department demands expensive apparatus and trained staff who can work as a team with physicians, surgeons, and physio-therapists.



X-RAY & ELECTRICAL DEPARTMENT
TÜBINGEN CLINIC : : : GERMANY
ARCHITECT : : HANS DAIBER

Fig. 100.

Moreover, changes in the nature of X-ray equipment, growing out of new knowledge of electronics and similar technical advances, must also be foreseen. These improvements will require flexibility of layout to permit their adoption. The planning must make provision for such future expansion.

In a small hospital of less than one hundred beds, it will usually be found that one of the newer portable machines will be adequate for all cases which the hospital and its professional staff are capable of handling. Any case beyond the ability of this type of machine will usually likewise be beyond the roentgenological skill of the immediately available professional staff to serve properly. There is, however, a growing tendency for the small hospital which cannot itself support a fully trained radiologist to avail

itself of the services of a consulting roentgenologist from some larger nearby community. In such case the extent of the equipment provided will be much greater—conditioned in fact on the ability of the hospital to finance it and the consultant to use it. In the larger hospital in which the most refined procedures must be carried out and the highly skilled roentgenologist is available to perform them, the more they are centralised the better and the more refined the equipment that will be justified.

PLANNING

The principal points to consider in planning the radio-diagnostic department are:

a space required in relation to bed capacity;
b easy accessibility from all parts of hospital;
c separate units: i.e. therapy, radiography, fluoroscopy, G.V., fracture;
d separate out-patient department;
e safety (i.e. lead-lined walls);
f adequate power supply;
g provision for built-in equipment (controls, etc.);
h specialised equipment (sanatorium, orthopaedic, children, etc.);
i provision for future expansion (as for mass chest surveys);
j darkroom facilities (tanks, dryers, revolving hatches, etc.).

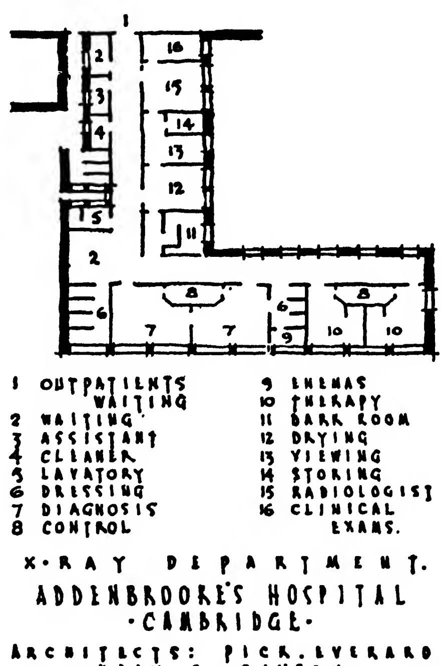


FIG. 101.

The radio-diagnostic department is generally used equally by both in-patients and out-patients, and should therefore be suitably placed in relation to both these departments. Its convenient relation to the wards and out-patient department is generally of greater importance than its proximity to the operating theatre. Under no circumstances should it be situated below ground-floor level. Whether it is planned in conjunction with the out-patients department or as a separate department, satisfactory connection must be provided by lifts, corridors, and doors of sufficient size to facilitate the movement of beds.

In general, the size of the radio-diagnostic department will depend upon the size of the hospital and volume of X-ray work to be handled. A preliminary study should be made of the expected daily average number of patients and the amount of diagnostic, therapeutic, and special X-ray work to be handled. Consideration should also be given to the area that the hospital will serve, as well as to the number of out-patients referred by local physicians for radio-diagnostic examinations or treatment.

Based on this survey, the number and sizes of rooms and the amount of equipment can be determined. It is desirable to plan for future expansion, so that space and facilities can be made available, at a later date, for additional or larger equipment at a minimum of expense. In planning, all rooms (including dark-rooms) should be provided with windows affording good natural lighting and ready facilities for admitting sunshine and fresh air whenever possible.

The following rooms should be considered in planning the department. In the small or specialised hospital certain of these rooms can be combined or eliminated. On the other hand, in the large hospital more than one of certain rooms will be necessary.

a Diagnostic unit will consist of radiographic room; combination radiographic-fluoroscopic room (in installations where the volume of work to be done is light, it is usual to provide combination radiographic-fluoroscopic facilities for the greater flexibility this arrangement affords); dressing-rooms with toilet.

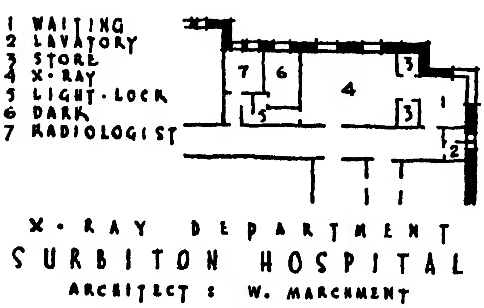


FIG. 102.

b Therapeutic unit will consist of deep therapy room (malignancies); superficial therapy room (dermatology); rest-room and dressing-rooms with toilet.

c Special units, consisting of cystoscopic room (genito-urinary), fracture room (fracture and bronchoscopic work); and out-patient department (mass chest work, etc.). Some of these rooms are frequently planned adjacent to the operating suite, and remote from the radio-diagnostic department. When so planned small-scale dark-room facilities should be provided adjacent, for prompt film developing during fracture reduction, etc.

d Dark-room unit. In the average hospital a single dark-room provides facilities for the following operations: film loading, film processing, film drying, and wet viewing. In large hospitals one or the other of these functions may be assigned to special rooms for efficient handling of large volume X-ray traffic.

e General unit. Some or all of the following will be required: waiting-rooms (general and private); roentgenologist's office; X-ray department office; film filing and viewing room; dressing-rooms and toilets; rest-rooms and lockers for staff; storage and supply rooms and linen-closets.

The Report expresses the opinion that this department is not suitable for the application of standards, as both the number and the size of units vary according to the extent and nature of the work done, and this differs very considerably in different hospitals.

The amount of space required is obviously dependent upon the amount and type of equipment to be installed, and this in turn is dependent upon the degree of professional

skill available to use it wisely. In general, allotments of space will run from about 450 sq. ft. of floor area for a hospital of one hundred beds up to 1,000 sq. ft. for a two-hundred bed hospital, this latter including space for roentgenotherapy.

Figs. 100 to 104 are plans of recent radio-diagnostic departments, and Figs. 105 and 106 are two typical layouts.

ACCOMMODATION

Waiting-room. The waiting-room should have a direct entrance from the corridor, but planned with door to shield corridor activities. It should be furnished with information desk adjacent to or in the room, chairs, table, and magazine racks, etc.

When dressing cubicles and toilets are required they should be adjacent to the X-ray room, so that they will open directly into it. Likewise there should be corridor entrances into the dressing-rooms, so that the patients can reach them without going into the X-ray rooms.

Film Store. The use of non-inflammable X-ray films is now usual. In the case of inflammable films, suitable precautions should be taken as regards their use and storage. Large stocks should be kept in isolated stores, preferably in a separate building or on the roof.

When non-inflammable films are used, the store may open off near the light-lock lobby, otherwise a room quite separate from the unit is required, in order to reduce the danger from fire to a minimum. A room of at least 100 sq. ft. is required, which must be kept dry and warm by means of heating pipes and must also be well ventilated and of fire-proof construction, with fire-proof doors. If windows are provided, they should be glazed with lead glass.

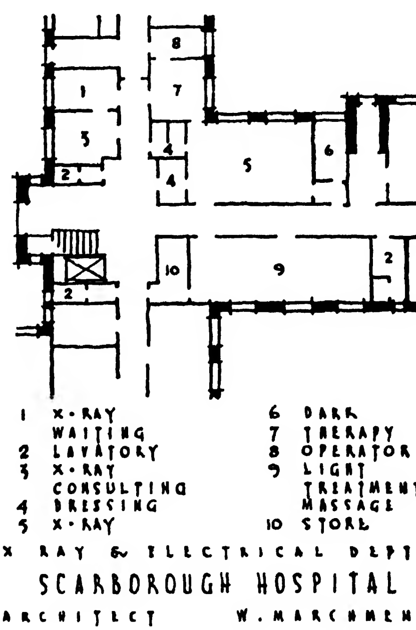


FIG. 103.

Dark-room. It is desirable that this room should adjoin the X-ray room to enable the approach to be through a light-lock lobby without doors. A room with an area of about 120 sq. ft. is required.

In planning the room, the wet developing section should be separated from the dry or loading section. A light-tight service door should be provided in the dark-room for the installation of the dark-room equipment. This door should be permanently locked after the installation is complete.

It is desirable to provide a wet film transfer illuminator on the wall, so located that

the referring physician and radiologist can discuss wet films remote from the patient. Adequate ventilation, either by natural ventilation or motor-driven type ventilators or a combination of both, is essential. A light-tight window (provided with light-tight blinds) which can be opened occasionally to air out the dark-room, is desirable. A ceiling-type dark-room lamp, with combination of white and red light, should be provided for general illumination.

The loading section of the dark-room consists of a loading bench with ample linoleum-covered space for loading and unloading films, built-in film bin, provisions for storage of cassettes, film holders and film hangers, a dark-room light, general storage shelves, and fireproof provisions for disposal of waste paper.

The developing section of the dark-room consists of:

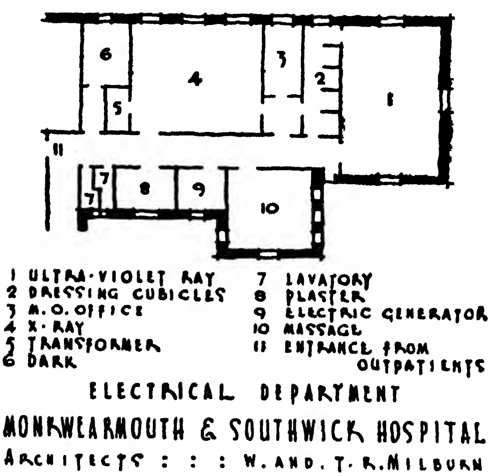


FIG. 104.

a developing tank, either the three-compartment type for small dark-rooms or the master type with various sized insert tanks for large installations;

b a rear shelf for the tank, including a built-in mixing valve, for obtaining correct water temperature, with the necessary water controls, thermometer timer, dark-room lamp, and film illuminator;

c a refrigeration cooling unit, if necessary, to maintain proper temperature of developing solutions;

d a wash sink;

e a film dryer or pegs for drying plates.

The floors and walls should be finished with terrazzo or tiles to allow for washing down, or alternatively the walls should be painted with a chemically treated paint specially made for the purpose. The colour should be either grey or green.

X-ray Rooms. The rooms should be of sufficient size to permit free movement and adjustment of the various pieces of apparatus, and to allow for the entrance and positioning of stretchers or wheel-chairs at the side of the table.

In addition to the protection-lined walls, a protection-lined control booth, fitted with a lead-glass window, should be provided in each X-ray room. This booth should be so placed that the operator will have an unobstructed view of the patient in all positions. The booth should have space for the X-ray control, with writing facilities and provision for storage of film markers, lead letters, thickness calipers, etc. It is desirable to provide a passageway between the control booths of similar X-ray rooms so that the operator can pass from one room to the other without going into the corridor.

There are rooms for various purposes:

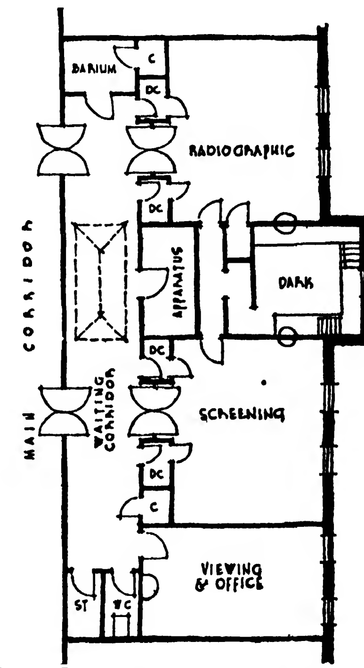
a Diagnostic room: this should be adjacent to the dark-room. It is desirable to provide transfer cabinet or a special light-excluding box of the revolving type in the wall so that cassettes can be passed directly into the dark-room from the diagnostic room. A small section of the room or a separate small room should be available for mixing barium, equipped with a small sink, a work table, an electric mixer, and a storage cupboard. A cupboard for storing accessories is also required. The windows should be provided with light-tight blinds in special baffle mounts.

b Therapeutic room; it is desirable to separate the therapeutic section from the diagnostic section. Good ventilation is especially important in this room. A cupboard for storing cones, pillows, sand bags, lead foil, etc., is required.

c Cystoscopic room; as in the case of the diagnostic room, dressing facilities, protection, control booth, etc., should be provided and a sink and separate toilet should be provided with direct entrance. The cystoscopic room (genito-urinary) should be convenient to the dark-room.

d Fracture room: the fracture room will handle such work as fracture reductions and bronchoscopy.

e Gastro-intestinal room: in most hospitals the gastro-intestinal work is dealt with in the general diagnostic room. However, in large hospitals a separate room may be advisable.



RADIO-DIAGNOSTIC DEPARTMENT TYPICAL LAYOUT

FIG. 105.

The minimum area of each room is considered as 250 sq. ft. with a height of 11′ 6″. The London County Council consider the rooms required for diagnostic purposes are separate radiographic and screening rooms, each preferably about 20′ by 20′ (the minimum being 16′ by 14′), with independent plants for each X-ray room, together with a number of dressing cubicles conveniently situated.

When X-ray generating apparatus employing mechanical rectifiers is used, it is preferably placed in a separate room from the X-ray tube, but quite near it. A convenient position is on the floor above—normally a mezzanine floor about 6′ 6″ high—with concrete floor and ceiling: this is a good arrangement which keeps the X-ray room unencumbered. The apparatus is fixed to the ceiling, and accordingly provision must be

made in the construction for carrying this weight. When permanent overhead conductors are employed, they should be not less than 9′ from the floor.

The windows should be ample for day-light operation, but they must be capable of being darkened with light-proof blinds for fluorescent screen examinations.

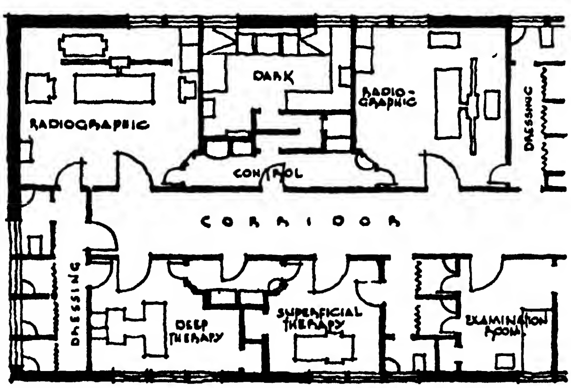
Viewing Room. The viewing room should be adjacent to the radiologist's office and filing room, with direct entrances from both rooms. It should be close to or adjacent to the dark-room.

This room is equipped with a stereoscope and multibank illuminators. It may be desirable to include film filing facilities in the viewing room.

Miscellaneous Rooms. Other rooms, such as offices, rest-rooms, linen-rooms, storage-room, etc., if required, may be planned to conform to similar rooms in other departments of the hospital.

PROTECTION AND FINISHINGS

Special precautions must be taken against the various X-rays used in this and the radio-therapeutic departments, and the walls and ceilings must be treated. The International Committee on X-ray and Radium Protection have made definite recommendations with regard to the construction and equipment, but as modern plants are so well protected, only the secondary radiation has to be guarded against. The X-ray tube in operation gives off certain stray rays, short time exposure of these rays is not harmful, but continuous long exposure may be so. These rays may be of such intensity as not to be stopped by ordinary concrete or glass, and it is therefore necessary to provide special shielding which will prevent indiscriminate exposure of persons or materials in adjoining areas. Shielding is a very expensive procedure and it is important that the matter be fully explored before undertaking an unnecessary and excessive expenditure, hence full information of the equipment to be used must be made available by the manufacturers of the equipment.



RADIO DIAGNOSTIC DEPARTMENT
TYPICAL LAYOUT

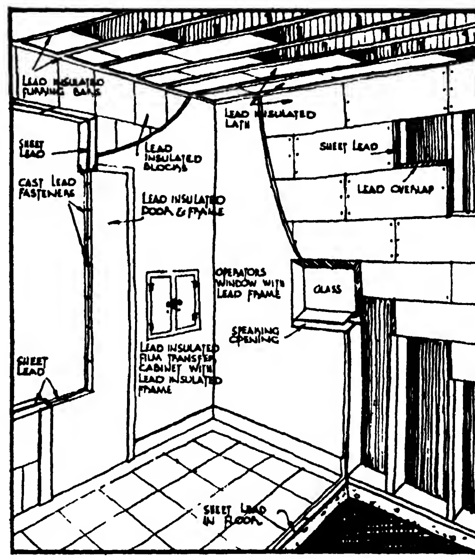
FIG. 106.

Further advice on protection questions can be obtained from the National Physical Laboratory of the Department of Scientific and Industrial Research and from the last Report of the British X-ray and Radium Protection Committee.

Fig. 107 is a diagram showing the normal protection provided in X-ray and similar rooms.

Floors. Protection should be provided if rooms in constant use are placed above or below the radio-diagnostic and radio-therapy departments. The floors should be lined with lead and finished with insulating material such as cork, linoleum, rubber, or teak on a timber frame, or terrazzo laid in squares.

Walls. Around the rooms used for radiological treatment, specially made barium-sulphate blocks rendered in barium plaster are used for the walls and ceiling. A brick wall, at least 5" thick will give as much protection as 1·5 mm. lead, which is the International standard of protection against 100 kilo volts. Another alternative is treble-lined cork and wire-mesh finally glazed with tiles. Walls coloured orange, buff, or beige are found to be most satisfactory to radiologists. Most of the units require their own control rooms, the walls of which should also be constructed of barium blocks to a height of 8′. The observation windows will be glazed with lead glass.



PROTECTION OF
X-RAY & SIMILAR ROOMS

FIG. 107.

Doors. Flush panelled hospital doors are used. The doors to treatment rooms must also be insulated with 6 lb. of lead, placed in two layers: the frames are also lead-lined. The doors are thus abnormally heavy and should, therefore, be fitted with quadrant floor tracks.

Blinds. To X-ray and dark-rooms, methods of darkening are by providing light-tight wooden shutters or closely fitting dark blinds or curtains. Possibly the best method is of light-proof cloth, with "zip" edging running in brass channels. All windows and shutters should be capable of being widely opened.

Heating. In these departments, the most satisfactory type of heating is by radiant heat beneath plaster panels, but special care must be taken in the placing of the panels so as not to affect the fixing of the overhead apparatus. A working temperature of about 65 to 70 deg. F. is desirable in the radio-diagnostic department.

Electricity. It will be appreciated that a separate system of cabling providing for the

different voltages is required, and both alternating and direct current should be available. Main and supply switches should be very accessible and distinctly indicated and not in the proximity of the high-tension system. It should also be impossible to close them accidentally.

Ventilation. This is an important point, unfortunately too often overlooked in the past, with resultant damage to the health of the assistants. The necessity for frequent flooding of X-ray and physio-therapy rooms with natural light, air, and sunshine is a factor of considerable importance.

Mechanical ventilation is normally necessary, not only for the X-ray room but also for the dark-room, for in these rooms—where constant use of the light-tight blinds is required—the atmosphere becomes very noxious. All rooms should be provided with adequate exhaust ventilation. For X-ray rooms of normal dimensions, say 3,000 cu. ft., in which corona-free apparatus is installed, the ventilating system should be capable of renewing the air of the room not less than six times per hour, while up to ten times per hour may be required when the apparatus is not corona-free. Large rooms require proportionately fewer changes of air per hour than small ones. Low-level air inlets and high-level outlets should be arranged to afford cross-wise ventilation of the rooms, and the extractors should be installed with light-tight baffles.

PLATE XXXV. Screening Room
Hospital Centre, Birmingham

PLATE XXXVI. Urological Room
Hospital Centre, Birmingham

[*To face page 206*

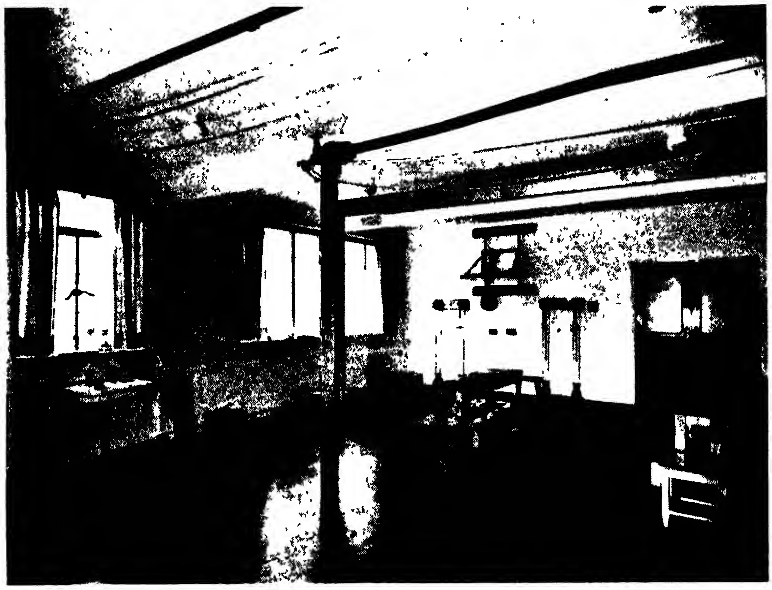


PLATE XXXVII. Remedial Exercise Room
Edgware General Hospital

PLATE XXXVIII. Anaesthetising Room
Hillingdon Hospital

To face page 207]

22

The Radio-Therapy Department

THERE IS NO radium department as such in Great Britain. There are, however, many radio-therapy departments, which include provision for X-ray therapy and radium therapy. The tendency now is to have separate X-ray departments, one for diagnosis (radio-diagnostic) and the other for therapy (radio-therapy), which also includes radium work.

Every hospital needs a radio-diagnostic department, but very few need a radio-therapy department—in fact, the general opinion is that a radio-therapy department should serve a population of not less than one million. This is because of the enormous expense of the apparatus and the special skill needed from those who use it. The work should therefore be concentrated, as supplies of radium itself will for many years only be available to the great central hospitals and research stations.

ACCOMMODATION

In view of the progressive development of the work and consequent changes in the apparatus, the International Committee on X-ray and Radium Protection should be consulted and the unit at the Royal Cancer Hospital, London, inspected.

Large rooms, each about 44′ by 22′ are required. In each of the rooms "cannon" (190,000 to 200,000 volts) connected to the apparatus in an adjoining room or on a mezzarine floor are provided. The cannon are easily operated with small motors. The floors to these rooms are usually of grey terrazzo and the walls of cream tiles to door height.

FINISHINGS

The protection and finishings described in Chapter 21 for the radio-diagnostic department are applicable to this department.

The dangers of over-exposure to radium can be avoided by the provision of adequate protection, and suitable working conditions. It is the duty of those in charge of radium departments to ensure such conditions for their personnel.

23

The Physio-Therapy Department

THE IMPORTANCE which Germany attached to matters of public health during the Nazi régime is responsible for the free and somewhat lavish expenditure on the building and equipment of health-giving centres. These centres were in the form of huge electrical and sun-treatment hospitals. To anyone contemplating such buildings, it is an inspiration to study the design of the Röntgen Institute at the Municipal Hospital at Frankfurt-on-Main (see Fig. 109); the Department at Mannheim; the larger Burger Hospital; the Hospital at Coblenz; and the Allgemeine Ortskranken-

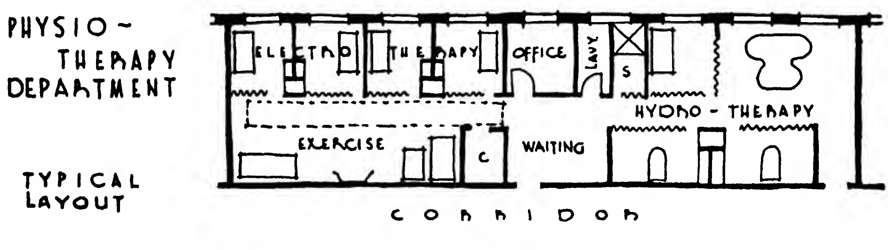


FIG. 108.

kasse at Cologne. The last was a huge light hospital, of some two thousand beds, built for the whole of Western Germany. Whether centralisation for physio-therapy on this scale is desirable is open to question; nevertheless, it shows the enthusiasm for this type of treatment.

PLANNING

In all large hospitals in Great Britain the physio-therapy departments are quite distinct from the radio-diagnostic departments.

The Report states that for this department, in view of the progressive development of the work and consequent changes in the apparatus, it is impossible to lay down standards. Accordingly, little will be written about the various units in detail. Sufficient to say that these departments should impress one with their lightness, their sense of spaciousness, and with the evidence of meticulous care and attention paid to the detail of the various health-giving units.

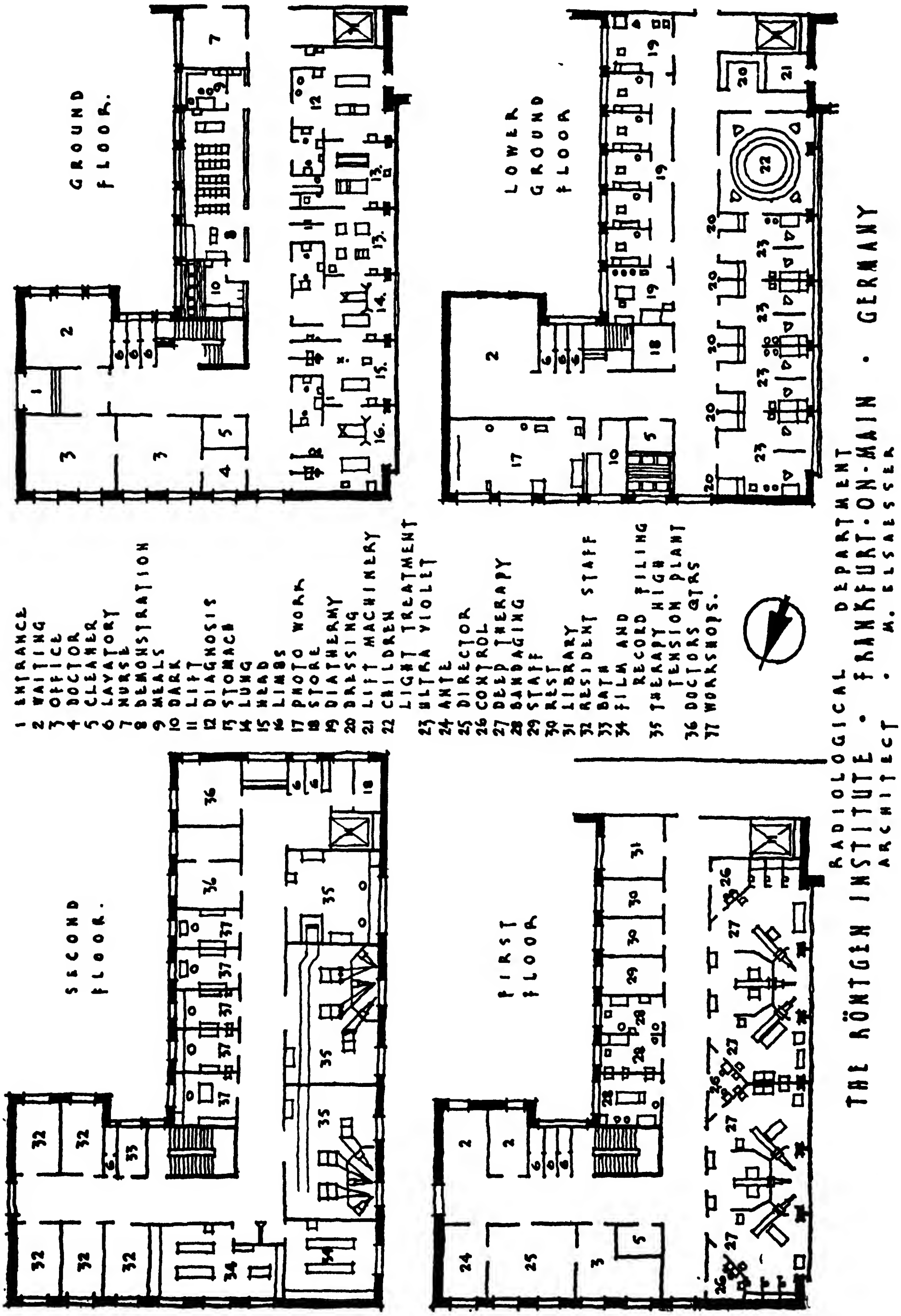

GROUND FLOOR.
LOWER GROUND FLOOR
SECOND FLOOR.
FIRST FLOOR
1 ENTRANCE
2 WAITING
3 OFFICE
4 DOCTOR
5 CLEANER
6 LAVATORY
7 NURSE
8 DEMONSTRATION
9 MEALS
10 DARK
11 LIFT
12 DIAGNOSIS
13 STOMACH
14 LUNG
15 HEAD
16 LIMBS
17 PHOTO WORK
18 STORE
19 DIATHERMY
20 DRESSING
21 LIFT MACHINERY
22 CHILDREN
LIGHT TREATMENT
23 ULTRA VIOLET
24 ANTE
25 DIRECTOR
26 CONTROL
27 DEEP THERAPY
28 BANDAGING
29 STAFF
30 REST
31 LIBRARY
32 RESIDENT STAFF
33 BATH
34 FILM AND RECORD FILING
35 THERAPY HIGH TENSION PLANT
36 DOCTORS QTRS
37 WORKSHOPS.
RADIOLOGICAL DEPARTMENT
THE RÖNTGEN INSTITUTE · FRANKFURT-ON-MAIN · GERMANY
ARCHITECT · M. ELSAESSER

Fig. 109.

Many existing hospitals are in difficulties through lack of space in this department; and it is essential that the equipment required should be considered first and the department planned in accordance therewith, space being allowed for possible future development. Under no circumstances should deep therapy units be located over floors regularly occupied by workers.

Fig. 108 indicates a typical layout for a physio-therapy department and Fig. 110 an electrical department erected in 1936.

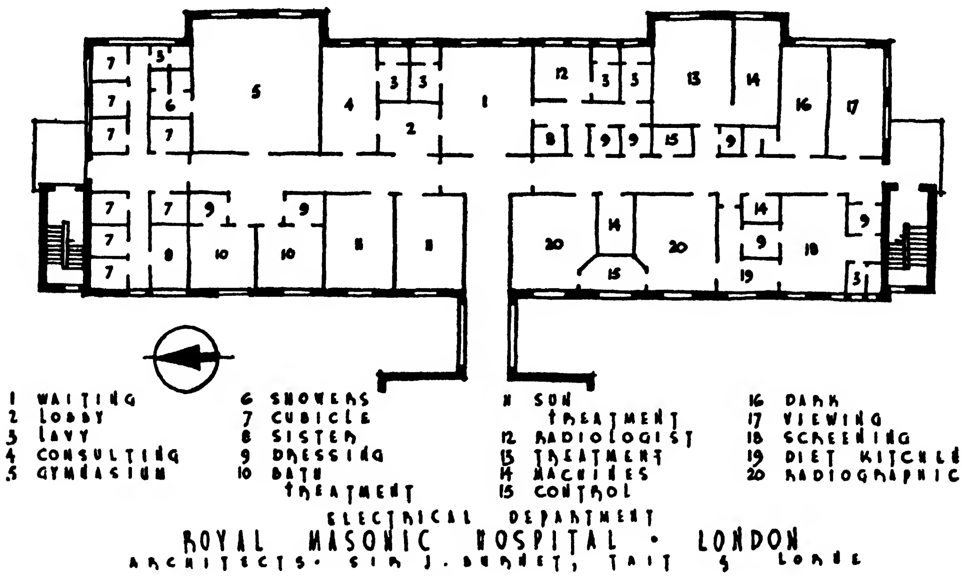


FIG. 110.

ACCOMMODATION

Normally there is a series or group of rooms forming a unit, sometimes on different floors. One floor would be mainly devoted to diathermy, ultra-violet light, and photography (other than the development of films). The rooms, for example, say diathermy, should be provided with grey terrazzo floors, cream-tiled walls (soft glazed) to door height, plastered walls and ceiling above. Small rooms and a separate children's room are necessary for the ultra-violet treatment unit with aluminium painted walls and heated terrazzo floor; dressing cubicles and toilet facilities will be required for each group of treatment. The rooms for light treatment should be convenient to the weighing-room and be well lighted and have ample floor space, with at least two clear walls for the fixing of apparatus; curtained cubicles about 10′ by 7′ are required, and each should, if possible, have a separate window and a lavatory basin in each cubicle, and in addition a foot-bath is desirable in some of the cubicles. The cork floor is normally marked with circles defining the treatment area. The room is equipped with dark blinds to windows and "Centrosal" and "Sollux" lamps.

All those units should be so planned that either sex can occupy the treatment rooms. This planning is provided by means of separate corridors or waiting space with separate toilet facilities.

Other rooms necessary in connection with the various units are offices, consulting-rooms, and a leisure room. It is most important that a room fitted with standard instruments to enable the various pieces of apparatus to be tested as desired be provided.

See Plate XXXVII for photograph of a unit.

FINISHINGS

A brief indication of the class of finishings to be provided has already been given.

Protection on the lines of the radio-diagnostic department is not needed.

The great heat given off by the carbon-arc-lamps requires carefully designed ventilation arrangements, and if the treatment rooms are small, mechanical ventilation will be required.

24

The Operating Theatre Department

THE OPERATING THEATRE is the focus of the surgical work of a general hospital. Reduced to its simplest terms, it consists of space arranged for the efficient and convenient performance of operations; this means that the planning, equipment, furnishing, and materials must be based on considerations of modern surgical technique and of the people who apply that technique.

The design of theatre units has now reached a very high standard of development, and, but for the requirements or idiosyncrasies of any particular surgeon, are now fairly standardised in plan; nevertheless, research on and development of equipment proceeds from year to year.

PLANNING

Conventional practice in acute general hospitals is to provide operating theatres at the ratio of about one to sixty beds. In the larger hospitals requiring several operating-rooms it is common to specialise a certain number of them, such as orthopaedic, urologic, eye, ear, nose and throat, or such other surgical specialities as require special arrangements or equipment and for which there is enough potential demand to justify such specialisation. The ratio of operating theatres to total beds may decrease quite markedly as the size of the hospital increases and particularly if the surgeons operate in the afternoon as well as in the morning hours.

The provision in some of the larger hospitals in Great Britain is;

- *a* general surgery, one theatre to fifty beds
- *b* aural surgery, one theatre to fifty beds
- *c* gynaecological surgery, one theatre to twenty-four beds
- *d* genito-urinary surgery, one theatre to twelve beds
- *e* ophthalmic surgery, one theatre to twelve beds

The size of the theatres has been gradually decreasing from the older two-storey amphi-theatre type to the present utilitarian size and one storey in height. Before the development of the modern surgical lights it was necessary to have sufficient space to move the operating table and its necessary equipment to such a position as was necessary to secure full advantage of either daylight or a stationary artificial light. But the

modern operating theatre light is so adjustable that there is no longer any need to move the operating table.

Since post-operative wound infections are most often due to infectious agents emanating from the noses and mouths of the persons in the theatre, it is apparent that the larger the operating theatre the more temptation there is to invite observers into the theatre itself rather than to limit them to designated and separate observers' gallery. Thus surgical as well as cost and architectural considerations agree that the theatre should be no larger than is required to permit desired arrangement of equipment and convenient working space for the theatre staff only. The Report found that the following rooms and dimensions represent a good average provision of the accommodation for an operating suite in a non-teaching hospital:

		SINGLE-THEATRE SUITE DIMENSIONS OR SIZE OF ROOM	TWIN-THEATRE SUITE DIMENSIONS OR SIZE OF ROOM
a	corridor	8′ wide	8′ wide
b	sister's room	—	100 sq. ft.
c	surgeon's changing-room, shower, and W.C.	150 sq. ft.	160 sq. ft.
d	nurses' changing room and W.C. ..	120 sq. ft.	130 sq. ft.
e	anaesthetising-room	140 sq. ft.	2/140 sq. ft.
f	theatre	22′ by 18′	2/22′ by 18′
g	sterilising-room and hand-washing facilities for surgeons and nurses ..	230 sq. ft.	300 sq. ft.
h	instrument cleaning and sink-room ..	90 sq. ft.	130 sq. ft.
i	combined linen and dressings-room, general store, and sister's room ..	170 sq. ft.	—
j	linen and dressing-room	—	140 sq. ft.
k	general store	—	80 sq. ft.
l	plaster-room (which might on occasion be used as a recovery room)	140 sq. ft.	140 sq. ft.
	taking advantage of roof lighting for some of the rooms, the above provision can be made within a total area inside external walls of	1,850 sq. ft.	2,900 sq. ft.

The London County Council have adopted a larger superficial area for some of these rooms and provide:

a operating theatre, 24′ by 20′ equalling 480 sq. ft.
b anaesthetising-room, 14′ by 14′ equalling 196 sq. ft.

In planning the hospital, the theatre suite must be located in such a manner as to be segregated completely from alien traffic and must be conveniently related to the surgical beds and access must be as direct as possible. Within the theatre suite, which

consists of the operating theatre and the ancillary rooms serving it, the relationships of the different rooms will be determined largely by the desirability of easy circulation. The ancillary rooms will provide for the sterilising of instruments and appliances; the anaesthetising of the patient; dressing and "scrubbing-up" by surgeons and nurses, the easy disposal and cleaning of the equipment used during the operation; and in some cases an X-ray and a dark-room (for the production of wet-plates in the shortest possible time during an operation).

Before the advent of modern operating theatre lights it was customary to place the operating theatre on the top floor with a northern exposure to take advantage of the more constant north light. But the modern operating theatre light is relatively cool, completely adjustable, and, more important, its light quality is constant as contrasted to natural light, the most consistent characteristic of which is its variability in quality. If there is no building over the theatre suite, the possibility of using roof lighting for some of the ancillary rooms facilitates planning; nevertheless top floor or bottom floor is immaterial, but as much segregation from other traffic as possible is obligatory.

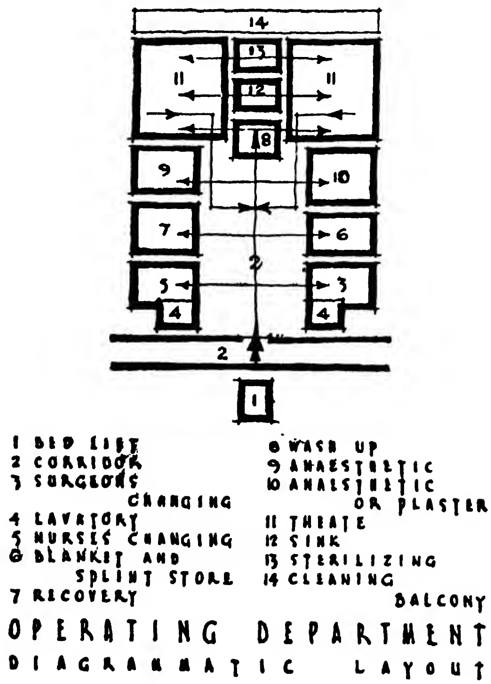


FIG. 111.

The layout and equipment for this department vary so much according to the requirements of each hospital that a general guide only can be given. The diagrammatic sketch (see Fig. 111) gives an analysis of the various units; the shapes given are not a correct indication of the sizes.

The modern tendency is to centralise all the operating theatres into one department. This avoids unnecessary duplication of sterilising equipment and the various ancillary rooms. Formerly it was customary to include an anaesthetic room for every theatre. but the present-day development of methods of quick induction of anaesthesia have materially decreased the use of such a facility. However, agents and methods for anaesthesia are changing rapidly and the provision of anaesthetising-rooms, at the rate of about one to each three operating theatres, is likely to be the future standard. Incidentally if not used for anaesthesia this room can often be converted to other use and working space in the surgical suite is always at a premium.

The theatres are usually arranged in pairs, with a sterilising and sink room common to both. With two or more theatres, a plaster-cast theatre and an X-ray theatre should be designed en suite.

Many arrangements and combinations of these rooms are possible, but in any which is to be satisfactory the traffic-flow must be simple, avoiding cross-circulations and unnecessary movement. Though ideal circulation may not be possible when considered in conjunction with other factors, easy and quick movement is of first importance. Fig. 112 indicates the circulations in the form of a simple diagram; the routine traffic in an operating theatre suite involves the movements of surgeon, nurse, patient, and equipment (including instruments).

The question whether or not there should be a separate building for this department is governed by whether such building can serve the relative part or parts of a hospital it is intended to serve, namely, can the patients be conveyed with ease and

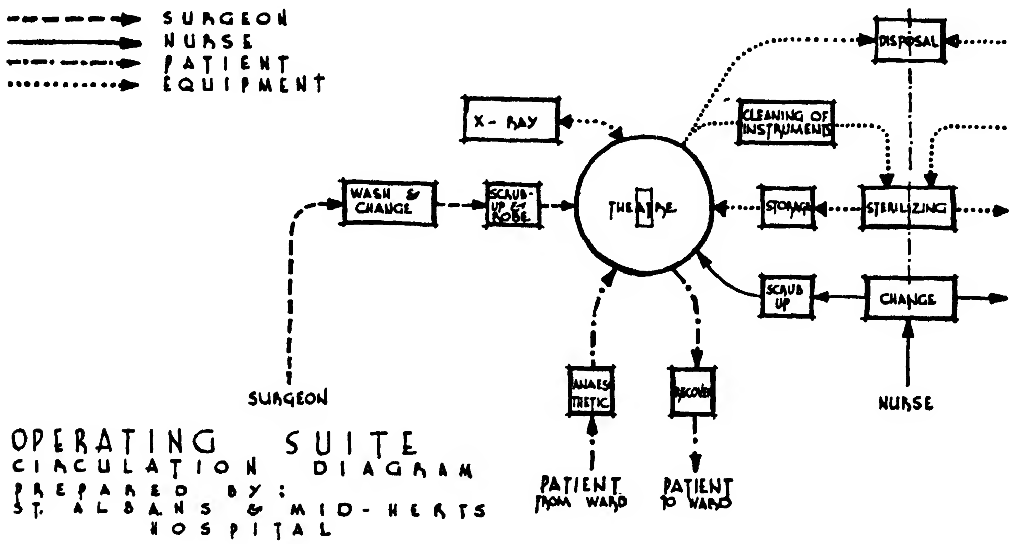


FIG. 112.

celerity and under cover to and from the wards or casualty or other departments.

The theatre should not open directly off the main circulation corridor, but should be isolated by a branch corridor at least 7′ wide, as this width is required to turn a theatre trolley. This branch corridor should also give access to the ancillary rooms. This will ensure quiet and privacy.

The anaesthetising-room should be entered from the branch corridor. It is desirable that there should be direct access from the anaesthetising-room to the theatre. Exit from the theatre should not be through this room, but direct into the branch corridor.

The surgeons' and nurses' hand-washing facilities should be outside the theatre, but immediately adjoining it, with open communication (see Plate XXXIX).

Several other rooms may be required in the immediate vicinity of the operating

suite, i.e. plaster-room and dressing-room for preparing splints, etc., not forgetting the theatre sister's room with telephone and light signalling apparatus.

In the case of a single-theatre suite the linen and dressings-room and the general store can be combined in one room, which can also serve as a sister's room. In a double-theatre suite it is preferable to separate the linen and dressings-room from the general store and to provide a sister's room in addition.

In large schemes, rooms with a repairer's shop attached are provided in a lower floor or basement for the preparation of dressings, general sterilising plant, instrument storage, and anaesthetic storage plant.

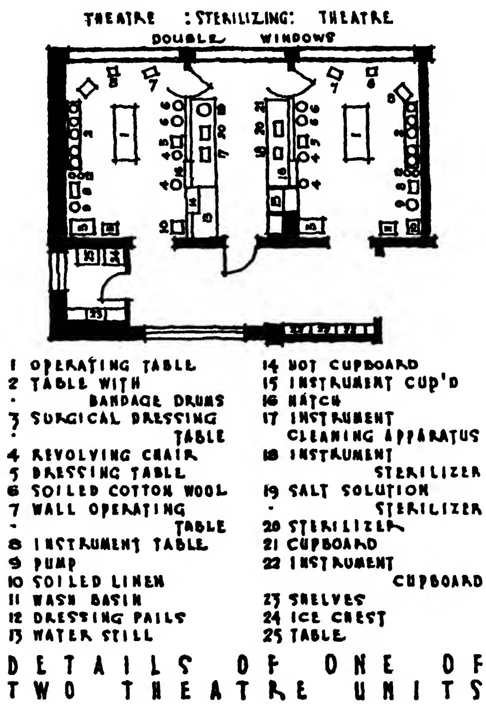


FIG. 113.

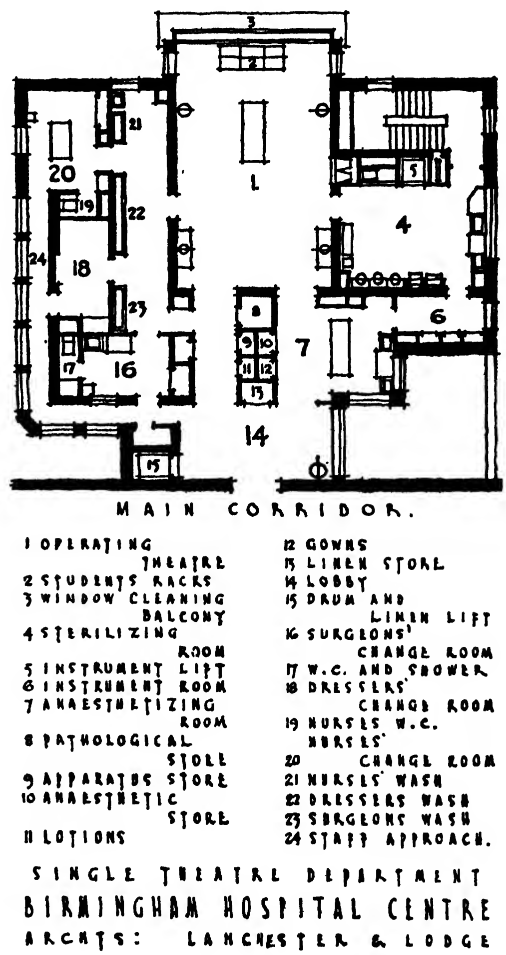


FIG. 114.

The requirements of these rooms and the equipment normally provided in them is given in previous and succeeding chapters.

The need of recovery wards is slowly dawning on the minds of most hospital authorities, and the entire disregard of the mental reaction of patients is giving way to more sympathetic consideration of their feelings. The provision of recovery wards in a small self-contained unit just outside the theatre may become standard practice, in

order to avoid the necessity of returning a patient still under anaesthesia into the general wards and limiting the distance which the patient has to travel. The recovery unit should be of single-bed wards, with a duty-room for the staff and a sluice-room.

The equipment of the operating theatre is largely movable and, while provision must be made for storage and handling on the basis of present practice, a certain degree of flexibility is desirable so as to avoid difficulties as developments in surgical technique involve the introduction of new equipment.

Figs. 114 to 120 and 123 to 126 are plans of recent operating theatres. Fig. 113 indicates in more detail the equipment in a theatre.

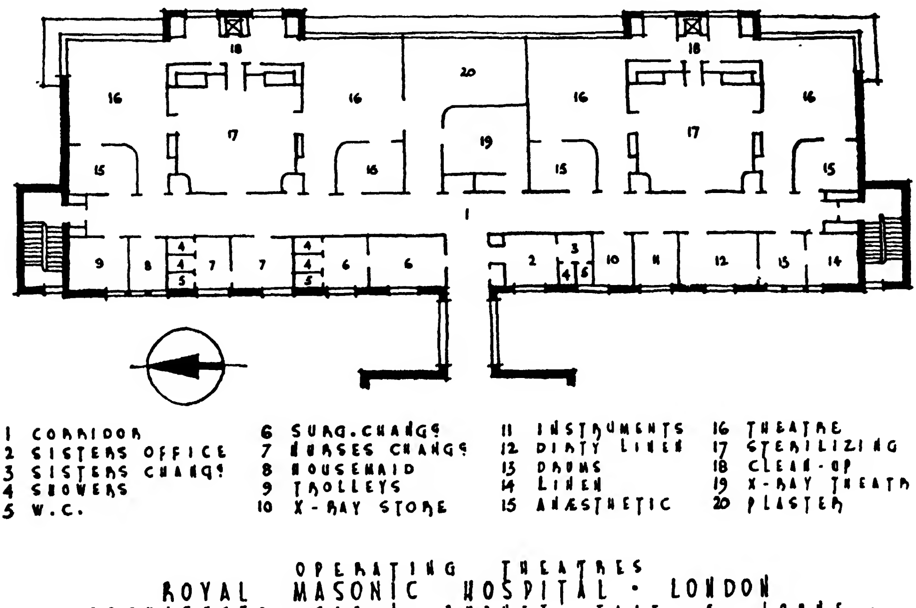


FIG. 115.

ACCOMMODATION

Changing-rooms. These rooms are for the theatre staff, and should be entered from the branch corridor. The layout of each is such that the surgeons, dressers, and nurses, when suitably clothed, have direct access to the theatres through the wash-ups.

The house-surgeons and nurses each have their own set of changing-rooms, and when employed dressers also require a changing-room. The first room is for changing of clothes and should be fitted with lockers and chairs, and there should be a lavatory and shower adjoining. The second room is for cleaning up and, besides the wash-up slabs, glass shelves are required for bottles, etc.; these wash-up shelves should be fixed to the wall nearest the theatre, so that the staff can pass direct into the theatre, after preparing for operation, without touching any door, etc.

The wash-ups, as they are known, may not be a familiar term to those not specialising in hospital design. One type is armour plate-glass fixed at an angle to the wall and, by means of arm or foot operated taps, surgeons and their assistants can wash their hands in running water, the temperature of which can be thermostatically controlled, all steam being mechanically exhausted. These wash-ups take the place of lavatory basins which used to be placed in the theatre. It is preferable if the wash-ups are placed in the approach passage from the dressing-rooms to the theatre, and if possible in front of a screen giving observation into the theatre, thus enabling the surgeons and others to supervise the preparations for an operation.

Anaesthetising-room. The patient is wheeled from the wards to the anaesthetising-room,

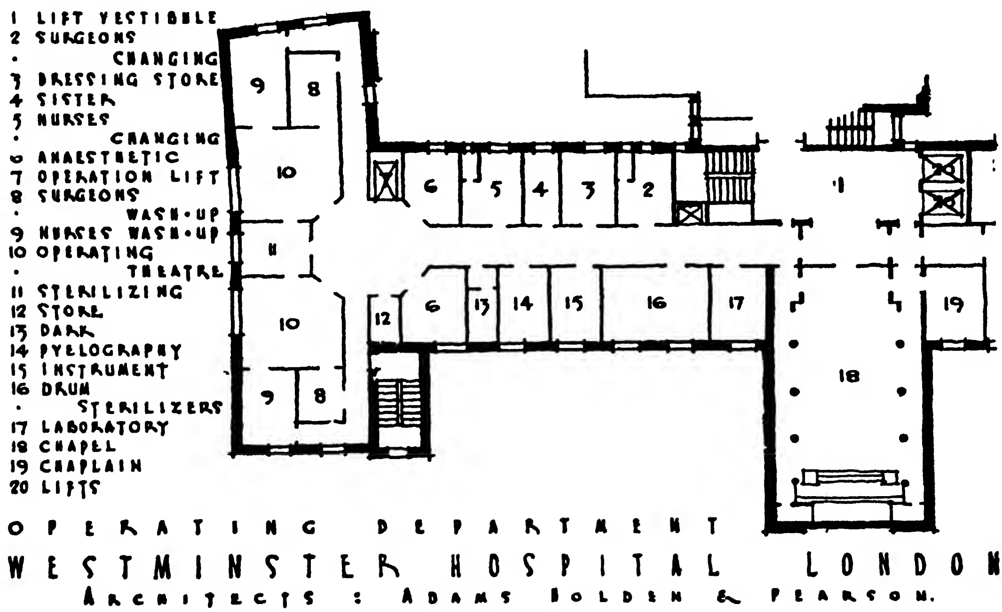


FIG. 116.

which is entered directly from the branch corridor. The branch corridor, being 7′ wide, allows a trolley to be easily turned into the room through double doors.

The fittings required in the room are a medium-size sink and drainer, cupboard for the anaesthetic apparatus, and a further small store for blankets (see Plate XXXVIII).

The best arrangement for the anaesthetic gases—in order to save having the cylinders in the department—is for the supply of anaesthetics to be kept in a room conveniently placed below, in which the large cylinders of oxygen, carbon dioxide, and nitrous oxide can be kept. From each cylinder, a supply pipe is taken up in the wall to the top of the building, with branches to the theatre and anaesthetising-room. The supply points should be brought conveniently near the head of the patient, and are required to be 2′ 6″ from floor. Each supply should be labelled in some foolproof manner. Some surgeons object to the idea of conveying these by means of pipes from a central supply

because their use is a matter of life and death, they are uneasy about the state of a supply located somewhere beyond their immediate control.

Considerations of heating and ventilation are of considerable importance, particularly as the risk of danger of fire from ether fumes must be borne in mind. The greatest risk of fire is from faulty switches in electro-medical apparatus used in the presence of ether.

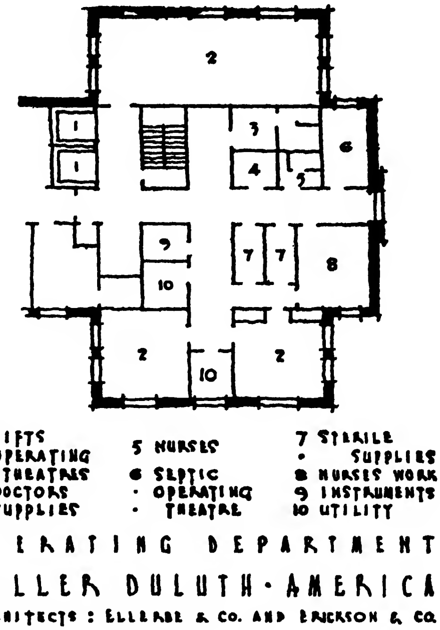


FIG. 117.

Theatre. Direct access must be provided from the anaesthetising-room to the operating theatre by double doors 4′ 6″ wide in the clear. It is an advantage if an observation window is provided in the doors.

The principles governing the planning of a theatre with the ancillary rooms are:

a. the circulation should be carefully devised to allow for the various movements;

b there should be the minimum crossing of the traffic routes of infected and clean or sterile materials;

c the nurses assembling and despatching sterile equipment to the operating theatre should be isolated from possible contact with infected material emerging from the theatre.

Opinions vary as to the necessity for providing top-light in addition to the normal north studio window, as so many operations are now performed entirely by artificial light, even during the hours of daylight. Mechanical ventilation and air conditioning have solved the problems of air supply irrespective of location and therefore windows can be entirely omitted if desired.

The operating table is placed roughly in the centre of the theatre, and over it is required a large scialytic lamp with an emergency lighting fixture (see Fig. 128 and Plate XXXIX). Recent American practice is to supersede the one lamp with a battery of lights.

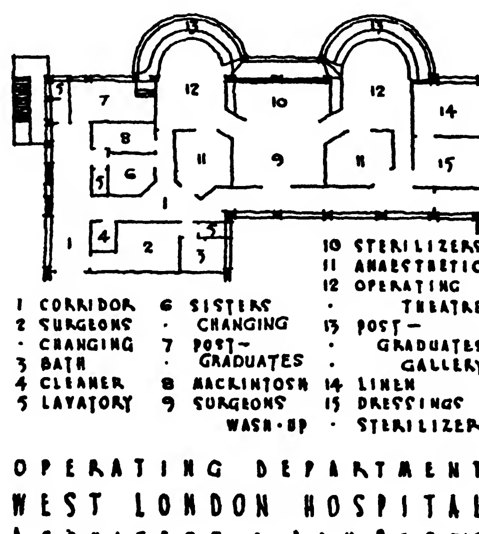


FIG. 118.

FIG. 119.

Near the head of the table should be the pillar through which passes the pipes conveying the various anaesthetising gases, and also the leads from the air pressure, suction, and electrical equipments, i.e. head lamps, diathermy, cautery, and so on. The pillar being placed centrally, it is not necessary for the leads to cross the floor, and the space around the table is therefore free from obstruction. The switches for electric light and power, head lights, and cautery transformer are placed on the walls.

With good sink and sterilising-rooms, or surgeons' and nurses' wash-ups, opening out of the theatre, there is no need for any lavatory basins in the theatre itself, as all these rooms should open directly off the theatre, without doors.

On the wall of the theatre facing the gallery, if provided—otherwise, on the right-hand side of the operating table facing the studio window—should be built-in X-ray viewing boxes under thermostatic control, of a size to hold two X-ray photographs at a time.

Other built-in cupboards—under thermostatic control—are required for instruments, salines, and blankets. These cupboards and X-ray boxes should be glazed with clear glass.

Exit from the theatre should never be through the anaesthetising-room, but direct into the branch corridor, and hence to recovery wards or back to the patient's own ward.

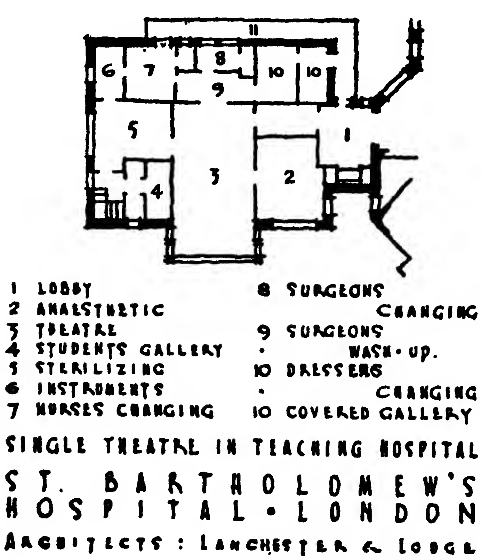


FIG. 120.

Students' Galleries. The theatres in hospitals with training schools have a gallery for the convenience of students, on post-graduate course, and other visitors. The provision for these students is one of the complications of theatre planning.

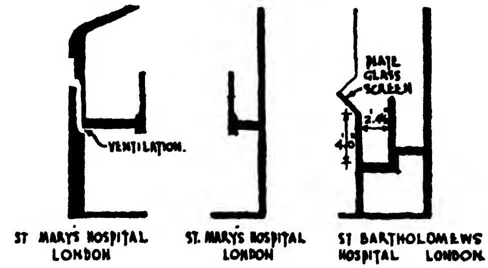
There are three methods:

a where they are admitted to the floor of the theatre;

b a gallery across the north wall, raised a foot or so above the floor;

c shallow galleries on three sides.

Scheme (*a*) needs no special planning, but only an increase in the floor area, and, of course, a students' changing-room where they can put on overalls and masks. This is the best arrangement for the students, but they do tend to get badly in the way of the surgeon and the nurses. Scheme (*b*) is the more usual plan, and this is the arrangement at the West London Hospital and at the Great Ormond Street Hospital for Children, London. In both these cases there are twin-theatres, and the students' gallery has been planned with the separate entrance and exit. At St. Bartholomew's Hospital, London, the students are in a gallery with two or three tiers of seats on one side of the theatre, with a plate-glass screen between them and the theatre. The objections to this are that it is difficult to hear anything said by the surgeon and the plate-glass is apt to become steamy if they breathe on it. At St. Mary's Hospital, London, scheme (*c*) is provided. Here the shallow galleries are placed on three sides of the theatre just above door height and only one person deep, and from the students' angle it is satisfactory (see Fig. 121).



STUDENTS GALLERY

FIG. 121.

For purely teaching purposes the scialyscope solves the problem by projecting the whole process of the operation, magnified three times, on to a screen in an adjoining room. It has the disadvantage of bulking very large in the theatre itself and being expensive to install. The eventual solution of student teaching probably lies in the provision of the scialyscope (in its future form), but the hospital must then have a medical school of sufficient magnitude to warrant such an expensive installation (see Fig. 122).

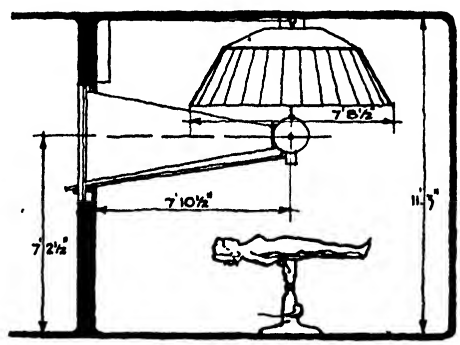
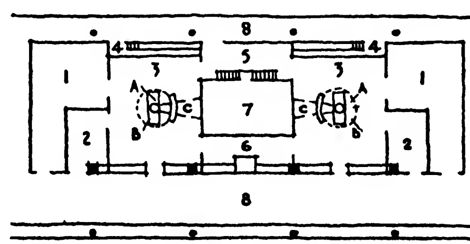


DIAGRAM SHOWING WORKING OF THE SCIALYSCOPE



1 RECOVERY
2 ANAESTHETIC
3 THEATRE
4 STUDENTS
5 SURGEONS SCRUB-UP
6 STERILIZING
7 VIEWING
8 CORRIDOR

A OPERATING TABLE
B LAMP
C SCIALYSCOPE

PLAN SHOWING VIEWING ROOM WITH TWO SCIALYSCOPE SCREENS BETWEEN PAIR OF OPERATING THEATRES.

LILLE HOSPITAL · FRANCE

FIG. 122.

Sink-room. This should be provided where soiled instruments are washed before being sterilised and where remains of the operation can be disposed of or cut up into microscopic sections; this room can be quite

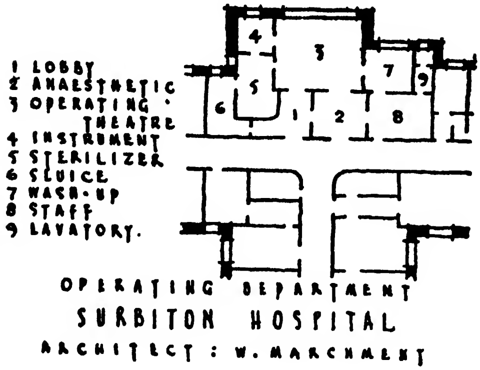


FIG. 123.

FIG. 124.

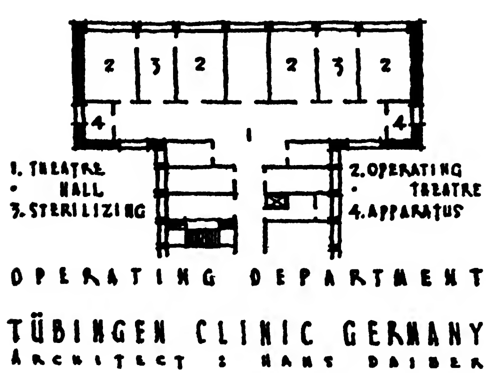


FIG. 125.

separate from the sterilising-room. In some hospitals there is a separate room from the normal sink-room for the preparation of microscopic sections. Together with the sterilising-room, the sink-room will be on one side of a single-theatre or, if serving twin-theatres, will occupy a central position between the two, the partitions all around being glazed screens above a height of 4′. A glazed screen should divide the sink-room from the sterilising-room, with an opening metal sash for the delivery of instruments and bowls to be sterilised. The circulation of clean and dirty instruments must be carefully considered, and a one-way system evolved.

The equipment will consist of sinks of various sizes (with open wastes to floor channels), with fireclay or teak drainers adjoining upon which instruments and bowls can be placed; in addition to washing and instrument sinks, a lotion and a slop sink are required. Provision must also be made for lotions, and clean and empty drums for the removal of soiled linen and surgical waste. Direct access to the outside must be made for linen bins, unless chutes are provided. Fireclay or similar lined chutes which discharge the soiled dressings into a receptacle at ground level are the most desirable. A cupboard for receiving pathological specimens removed during operations will be provided.

Sterilising-rooms. The size of the sterilising-room given in The Report is based on the assumption that the dressing sterilisers will not be in this room (see Chapter 19). A suite of rooms for the preparation and sterilisation of dressings in bulk for the whole of the various units is usually provided in a central position in the hospital, and the

dressings and gloves are brought to the theatre in sterilised air-tight drums whenever they are wanted; therefore the only sterilising required in the operation department is for instruments, bowls, and water.

The sterilising-room should adjoin the theatre and should not be provided with any entrance other than from the theatre, except that there can be direct access to the adjoining sink-room. The entrance to the theatre should be a wide clear opening, not fitted with a door.

There are various types of sterilising equipment and, when considering the qualities of each, it must be remembered that the bugbear to the nurse of sterilisation is the prevalence of live steam. The layout should, therefore, be designed to keep the room free from it, only valves, gauges, and doors showing in the sterilising-room (see Plates XL, XLI and XLII).

Normally, even with twin-theatres, each theatre has its own instrument, glove, and bowl

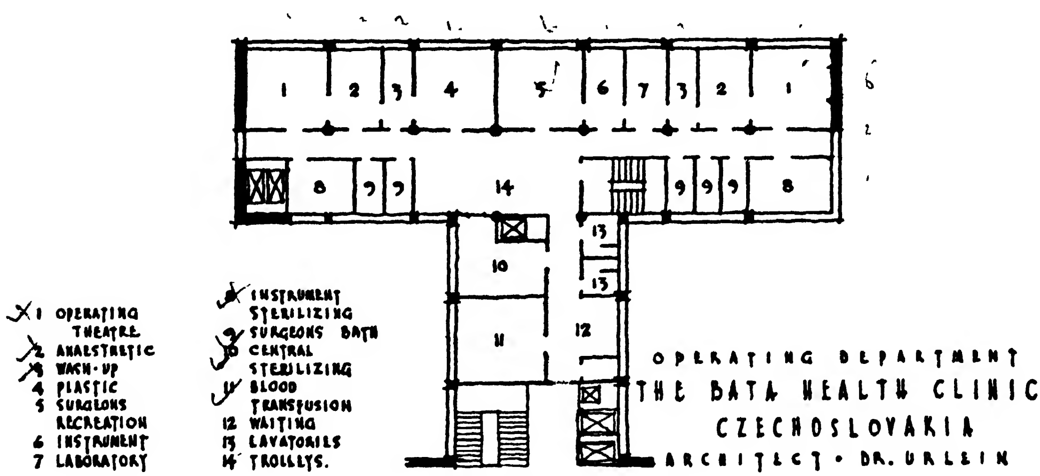


FIG. 126.

sterilisers together with hot and cold water sterilisers. Distilled and sterile water and saline solution must be taken straight from the tap, which will be either foot or arm-operated.

There are now types of built-in sterilisers which look like recessed kitchen ranges. Another type consists of autoclaves built into the wall, where sterilisation is done by steam. Both depend for proper working on adequate access for the fitters to all the multitudinous supply pipes that are concealed. Access to these pipe lobbies must be external to the theatre altogether.

The major part of the exposed equipment should be stainless steel or monel metal.

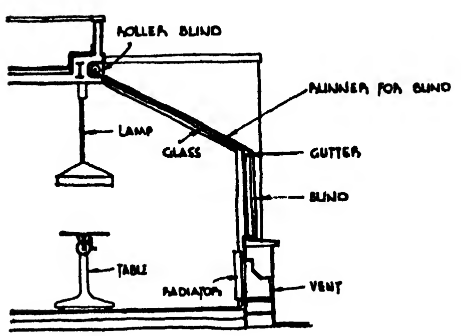
Recovery Ward. One of the ancillary rooms justifiably growing in favour is the recovery ward. This is a small ward designed for care of patients during their first 24 hour post-operation period. Its particular advantages are that such a ward justifies the provision of specially trained personnel and of all the special facilities likely to be needed

to meet early post-operation emergencies and thereby permits much less elaborate equipment of the surgical wards and the use of fewer specially trained nursing personnel in the ward areas.

The capacity of the recovery ward will usually be from three to four beds for each major operating theatre. This, however, varies quite widely, as some surgeons prefer to keep their patients in the recovery room for at least 24 hours or until danger of a post-operative emergency, such as shock or haemorrhage, is past, while others desire them kept only until they have fully reacted from the anaesthetic. The capacity for patients and the extent to which the equipment will provide for emergencies can be determined only in the light of the practices preferred by the surgeons.

ACCESSORIES TO THEATRE SUITE

Windows. The normal theatre window is known as the studio type and should be practically the full width of the room and extend from about 4′ above the floor to the ceiling (see Fig. 127).



OPERATING THEATRE WINDOW

FIG. 127.

It is usual to have a large fixed centre-light with side-hung casements on each side and a top-light usually at an angle of 45 deg. The whole window should be of metal with as few projections as possible. Some windows are equipped with external water-sprays for cooling in hot weather.

An external balcony is required for cleaning the lower half of the window, and a little ledge along the ridge from which the upper half can be washed (see Fig. 130).

A satin-finished glass such as "Thermolux" is most suitable for the glazing of theatres, because it combines complete light diffusion providing freedom from glare; reduction of heat losses in cold weather; insulation against solar radiant heat; has easily cleaned flat and polished surfaces on each side; and finally has adequate obscuration and pleasing appearance.

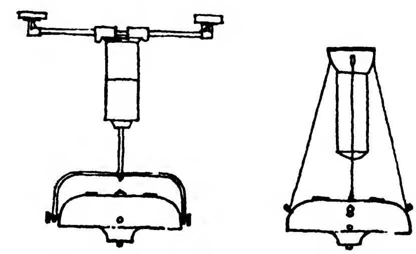
Double windows are often provided in Continental hospitals, with electrically operated dark blinds in the space between the windows.

Dark Blinds. Some operations require darkened conditions and therefore the theatre windows are usually fitted with external blinds which can be operated by hand-gearing or electrically controlled. External waterproof blinds are not particularly satisfactory owing to speedy deterioration, and therefore double glazing with a roller blind between the inner and outer glazing is a solution. The weight of opinion seems to be against attempting to darken the theatre for operating purposes.

For obscuring the glass or reducing the heat of the sun, the use of a wash of colour or jets of water appears to be appropriate.

Lamps. The lighting of the operating theatre is usually supplied from three independent sources, two from the supply company's main and one independent source storage battery.

An automatic electric plant safeguards against the failure of electricity just when the theatre requires it, for it is in an emergency that the need for light is even greater than before. The plant must be completely automatic in operation, and restore a full supply in the event of a failure in the public supply. The plant, serving only the operating unit (twin-theatres), occupies no more than approximately 5′ by 2′ of floor space. The model selected should have perfect balance and smooth running, permitting its location on any upper floor if necessary. Emergency lighting will always be provided to the theatre and one point in the sterilising-room, anaesthetising-room, and entrance lobby.



KINDS OF SUSPENSION FOR OPERATING THEATRE LAMPS

Fig. 128.

For theatre lighting, a central prism light is generally adopted. This can hang from a fixed point, or from rails on which it can be moved to one end or the other of the length of the table (see Fig. 128). The unit selected must provide high lighting intensity and a very wide margin of safety in the suspension equipment. Although there is no record of an anaesthetic explosion due to ignition by the theatre lamp, the safe course is to install a lamp certified as explosion proof.

Special requirements of an operating theatre lamp are:

- *a* great depth of shadowless field
- *b* absence of heat
- *c* freedom from glare and shadow
- *d* daylight tinted illumination (true colour rendering)
- *e* automatic emergency system (provision against lighting failure).

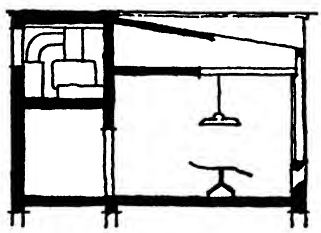
A number of lights for general lighting will also be provided.

In America the use of daylight for operating has been entirely abandoned on the grounds that the only consistent characteristic of natural light is its variability. They contend the requirements for an operating theatre are high intensity of lighting on the operating area, manoeuvrability and adjustability sufficient to adjust the areas of the cone of light to the areas of the operating opening. Therefore external windows are not required.

Ventilation. The theatre should have a fully equipped air-conditioning and humidifying plant allowing ten complete changes of air per hour. Conditioned air is maintained at

the required temperature, and the provision of radiators in addition enables the temperature to be raised rapidly when required.

Conditioned air heating is the best for theatres provided that the conditioning plant can be placed immediately outside the theatre suite and that the inflow duct is of the shortest possible run. This mechanical conditioning plant should be placed on the roof. If other accommodation is provided above the theatre unit, then a mezzanine floor must be introduced. When the ducts are more than a few feet long they are dust traps, and the dust may be blown into the theatre. The hot air is introduced at a high level and the foul air extracted about 5′ above the floor; in this way the deposit of dust by convection currents on the ceiling is reduced to a minimum. The fresh, warmed, filtered, humidified air should enter the theatre through plain terrazzo ducts and rustless movable grilles with dust screens. With any form of radiator or convection heating the

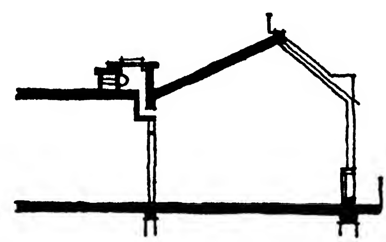


TÜBINGEN CLINIC GERMANY

VENTILATION

DOUBLE WINDOWS ARE USUAL IN CONTINENTAL HOSPITALS. AIR CONDITIONING PLANT IS PROVIDED ABOVE THE LOBBY

FIG. 129.



QUEEN CHARLOTTE'S HOSPITAL LONDON

VENTILATION

SINGLE WINDOW OPENING, VENTILATION WHEN REQUIRED. POWERFUL FAN DRAWS AIR FROM BATTERY OF RADIATORS PLACED UNDER WINDOW, THEN ACROSS THEATRE TO EXTRACT DUCT.

FIG. 130.

ceiling will get dirty within a short period, and this happens all the more quickly because theatres have to be kept at a temperature of 65 to 80 deg. F.

For simplified ventilation, a battery of radiators enclosed on both sides by metal doors can be introduced under the studio window. The outer doors are lagged against heat loss, but have a fresh-air inlet in which is fitted a removable gauze screen; the inner doors are slotted. A powerful fan on the other side of the theatre draws air through the gauze and finely woven muslin screen, past the radiators, out through the slots and across the operating theatre. The metal doors allow the whole arrangement to be opened up and cleaned with that thoroughness necessary in theatres (see Fig. 130).

Heating. The theatres should be warmed to a general temperature of 65 to 80 deg. F. by panel heating or flush panel radiators, cleaning then being simplified. If hospital column radiators are used, they should be hinged to swing out from the walls for cleaning purposes.

Consideration must be given to the provision of heating in the summer when the

normal heating services are closed down. This difficulty can be overcome by providing a large radiator fed from the steam services working at 10 lb. per sq. in. pressure or less, according to services available in the vicinity.

The various types of heating are fully considered in Chapter 37. Electric heating will, no doubt, come into general use one day, but is now used only as an auxiliary heat.

FINISHINGS

In the choice of materials for the finishes of the theatre, the over-riding criterion must be the ease with which they can be kept clean, by the standards of surgical practice. By implication, they must either have a high degree of durability to withstand satisfactorily the constant and thorough cleaning which they will receive, e.g. tiles or glass, or they must be renewable from time to time, e.g. hard-gloss paint.

As operating suites require continuous washing out, there does not appear to be anything better than a terrazzo finish for the floors and the walls, the most restful colouring being grey, green, or sky blue. In view of the necessity for frequent cleansing of the theatre, special attention to the surfaces is also desirable from the standpoint of economy in maintenance. Special attention should be given to the ceiling surface, which should be treated in such a way as to obviate condensation of moisture.

The floors should be laid with slight falls to channels with special gullies; and it is essential that all corners and angles be coved at the junctions.

At the Royal Masonic Hospital, London, the floors and walls are in light green terrazzo and the ceiling is in hard plaster, painted with light green enamel. The fittings are in stainless steel. At the Infectious Diseases Hospital, Paisley, the suite is entirely painted in pale olive green (eau-de-nil).

The Report recommends terrazzo, laid in squares (to reduce cracking), for floors to theatre, sterilising and sink-rooms, and hardwood or terrazzo for other rooms. The walls of the former to be in tiles or terrazzo, and the other rooms plastered and painted, the lower 4′ 6″ to be hard plaster.

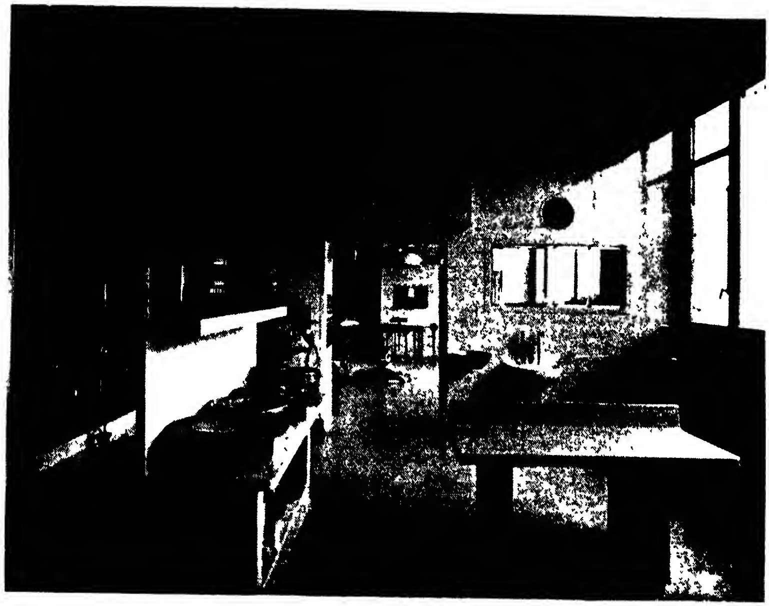


PLATE XXXIX. Sterilising
Great Ormond Street Hospital for Children, London

PLATE XL. Sterilising
Hillingdon Hospital

[*To face page 228*

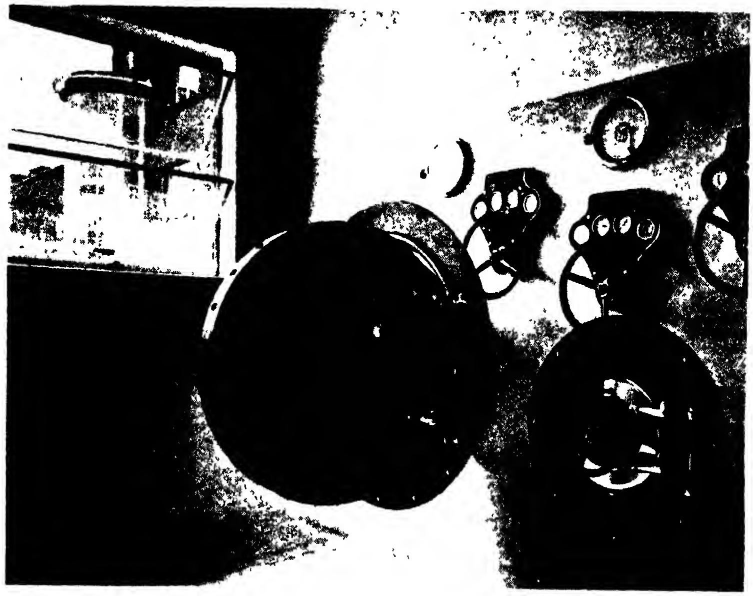


PLATE XLI. Sterilisers
Royal Masonic Hospital, London

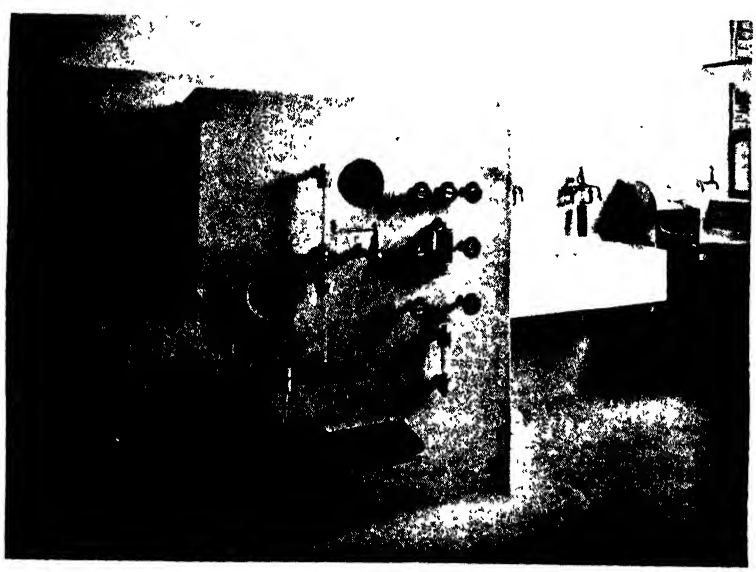


PLATE XLII. Sterilisers
Royal Masonic Hospital, London

To face page 229]

SECTION V

Special Wards—Provision of wards often provided as ancillary to acute wards but forming part of a general hospital

25

Paying Patients

TO THE WELL-TO-DO the effects of illness may be minimised by their capacity to pay for accommodation and treatment in fashionable nursing-homes; to the poor the alternative to treatment in their own homes by the panel doctor is provided by the hospitals. But to the middle classes, whose incomes do not permit them to afford extravagant nursing-home charges and who are not eligible for free hospital admission, the problem of treatment often assumes a terrifying aspect when they are faced with grave illness.

Accommodation in the smaller home is restricted, and it is literally true that in thousands of middle-class homes there is no room for the treatment of illness, especially of the serious type which necessitates the attendance of day and night nurses. Quite apart from the prohibitive charges incurred by such constant attendance, the consequent disorganisation of the household is intolerable to all concerned.

Private ward accommodation is normally necessarily restricted to an extent, as vacancies cannot be timed with the necessity of application for admittance. There is a general reluctance on the part of members of the middle classes to sharing a hospital ward common to many, particularly where the inmate is charged for treatment and attendance equally shared by non-paying patients.

Practically all general hospitals now have a private patients paying block where people of limited means can book accommodation and receive hospital treatment. This was an increasing need, as it was fast becoming the only available accommodation where patients of moderate income could take advantage of the modern hospital equipment and treatment. Such private blocks were also a source of income to the hospital, and, according to the district, were either a few single-bed wards set aside for paying patients or a complete self-contained block with its own operating theatre and treatment rooms.

PLANNING

There should if possible be a separate entrance to the private patients wing and this should be in direct communication with the general hospital, as it is usually planned so that all the services of the general hospital, such as radio-diagnostic, physio-therapy, etc. will also be available for the private patients' benefit. This is a difficult department

to plan if it is not entirely self-contained, as it means sharing the central and diet kitchens, etc. Separate kitchens, of course, mean the expense of a separate chef.

See Figs. 131 and 132 for units at Leeds General Infirmary.

ACCOMMODATION

Wards. As to the size of wards, there is diversity of opinion on the matter of single or multiple-bed wards. Many hospitals have a contributory scheme running, and in return place cubicles or small wards at the disposal of contributors at a fairly low weekly

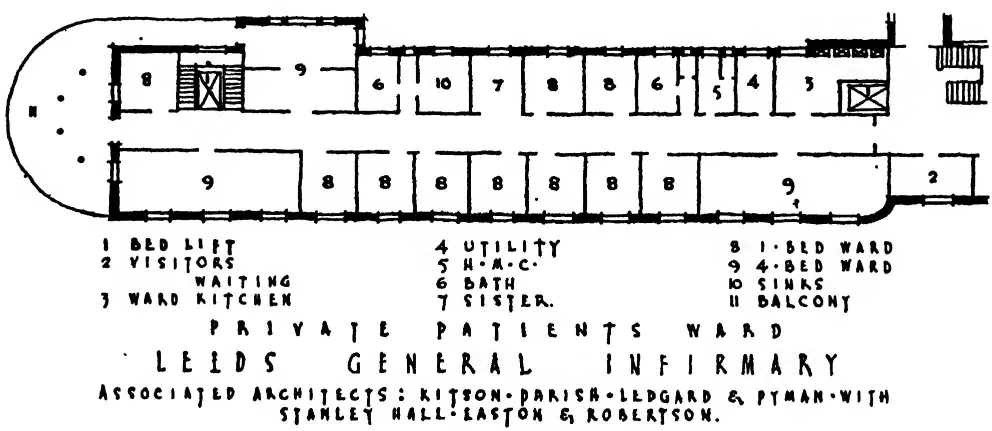


FIG. 131.

charge. At such charges, it is not economical to have single wards, which naturally take more nursing and cost more to run. The planning of these units must be very elastic, as the rooms may be occupied at different times by a different ratio of men and women. A good principle to follow is to have sanitary conveniences at the extreme ends of each floor of the private wards with access at either end, so that either sex may expand from one floor to another as occasion demands. Some of the wards should be large enough to take a patient's bed and cot if required.

In the provinces accommodation for paying patients is provided in single rooms, cubicles, and in small rooms. The single ward and the small ward are generally more popular than cubicles. It will be found that a much larger proportion of the accommodation in the small hospitals is directed to "pay beds" than in the large hospitals.

Whether or not it is desirable to provide single-bed wards only for acute medical and surgical cases is a debatable question. The general opinion seems to be that a high proportion of single-bed wards is desirable, with very few two-bed wards, which are not popular except for elderly patients desiring a relative or special nurse in constant attendance or for a child and mother. The general consensus of opinion seems to be that the number of beds should be divided equally between single wards, four-bed cubicle wards, and four-bed associated wards.

In addition to the usual facilities, every patient should have a bedside reading-lamp, and the single wards are provided with coal or electric fires, made interchangeable. Telephones for each patient is not recommended, but if plug points are provided a telephone instrument can be installed if required. Each ward should have a colour-scheme of its own, and all schemes must be cheerful and of restful tints. Walls spray-painted are very suitable, with curtains and hangings in keeping.

Ancillary Rooms. In addition to the ancillary rooms usually provided in ward units, the following rooms are also required for private blocks: a porter's room for receiving parcels, flowers, etc., for the patients; a flower pantry; a visitors' waiting-room, preferably on each floor, and a consultation room where the doctors can interview the relatives of the sick. Sometimes, it is desirable to provide a room where relatives may stay all night in urgent cases.

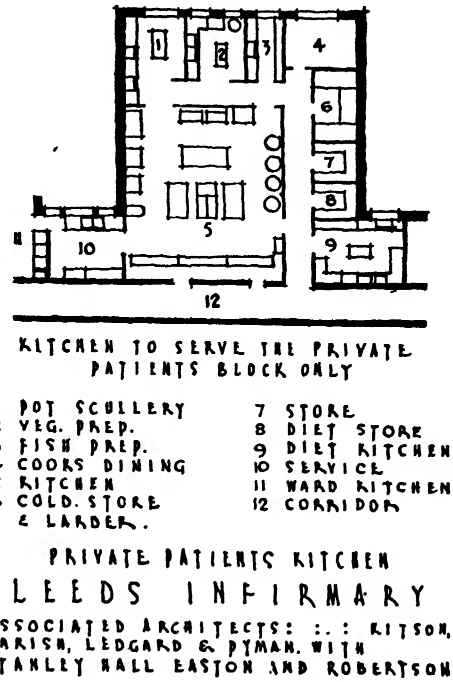


FIG. 132.

Special Departments. Whether the provision of a separate operating theatre and physiotherapy department is necessary or desirable depends on local conditions and the general layout of the main hospital buildings. If the pay bed block is some distance from the main operating block a separate one is desirable. It is generally agreed that one should be included when upwards of thirty beds are provided.

26
Chronic

WHEREAS THE TERM "acute" refers to patients whose condition calls for medical or surgical treatment, the term "chronic" is the condition when a patient has reached a stage that active medical and surgical treatment is of no avail, but the patient remains in need of continuous nursing care, and in order to release a bed in the acute ward and for his own comfort, he is transferred elsewhere. It is for such patients that the so-called "chronic wards" are intended.

The care of the chronic sick, despite its neglect by the voluntary hospitals and its lack of glamour, is one of the most important of the humanities. In the past chronic patients have been transferred to obsolete wards, often with inadequate ventilation; this is to be deprecated as adequate ventilation is essential for these old people who are incontinent.

Although special hospitals may be provided for this class of patient (see Chapter 32) it is generally accepted that some accommodation will be provided as a part of a general hospital, for there are certain advantages in this course, e.g.:

a patients suffering from chronic illness may from time to time require active medical treatment necessitating their transfer to acute wards;
b may require some form of special investigation or physio-therapy treatment;
c difficulties may arise in staffing because chronic cases do not provide sufficient interest or range of experience; when it is part of a general hospital a better type of staff is more readily available.

It is now generally accepted that some wards for the chronic sick, the infirm, and slowly dying will be provided in a general hospital scheme so that they may be nursed near their friends and relations.

PLANNING

When compared with an acute ward, the treatment in a chronic ward is simpler, changes of patients are much less frequent, and the amount of clerical work is very much less; and accordingly, provided that the sister has adequate trained assistance she can supervise a greater number of beds than the sister-in-charge of an acute ward.

The degree of division of the ward unit into separate wards has a bearing on the

question. It is easier to supervise a given number of patients in one or two large wards than in several smaller wards. The Report is of the opinion that if a unit consists of two large wards and a few single-bed wards, and the necessary trained assistance for the sister is provided, a ward unit may contain up to sixty beds.

ACCOMMODATION

Wards. It is agreed it is necessary to provide some degree of classification, but it is not possible to specify precisely the degree of sub-division which should be provided in a ward unit, as this must depend on the number of the different groups of patients to be provided for. Unless therefore, the numbers in each class are large enough to occupy large wards, there should be a sufficient number of smaller wards to admit of proper classification. Division of a long ward into sections by means of transverse glazed partitions meets this requirement reasonably well, though separate wards are preferable. In every ward unit there should be some single-bed wards for the separation of certain patients, in their own interest or that of others. The Report recommends that for this purpose there should be six single-bed wards in a ward unit of sixty beds.

All wards in the past have been designed on the transverse layout for beds, but if the longitudinal layout is adopted the disadvantages referred to in Chapter 18 must be accepted and may necessitate an increase in staff.

Traffic in the wards is much lighter than in an acute hospital and any treatment given is of a simpler character, therefore less working spacing is required. Wards—when the transverse arrangement of beds is adopted—need not be more than 24′ wide and a space of 7′ between bed centres is sufficient, while for single-bed wards an area of 100 sq. ft. will suffice.

The temperature required for aged and infirm persons is 65 deg. F., while in wards used as dormitories 55 deg. F. will suffice.

Day-rooms. Except in ward units reserved for bed-ridden cases, a day-room will be required. These rooms can also be used as dining-rooms. The size must be based on the number of patients expected to be able to use it; and while no definite standard can be laid down, a minimum area of 240 sq. ft. is suggested in The Report. These rooms will be heated to a temperature of 60 deg. F.

Ancillary Rooms. The differences in the ancillary rooms as compared with an acute ward (see Chapter 18) are due to the following:

- *a* bathrooms should be larger to allow space for handling helpless patients;
- *b* owing to the simpler treatment and lesser amount of activity generally, the ward office and the duty-room can be combined in a single room;
- *c* the ward kitchen must be larger, as it serves a larger number of patients.

The Report considers the ancillary rooms should consist of the following rooms of the areas shown:

a two sluice-rooms, each 130 sq. ft.
b two bathrooms, each 90 sq. ft.
c ward office and duty-room, 100 sq. ft.
d kitchen, 240 sq. ft.
e linen store, 100 sq. ft.
f general store, 100 sq. ft.
g two patients lavatories, each with two W.Cs.
h staff lavatory and W.C.
i cleaners' room.

See Chapter 32 with special reference to lavatory basins (Fig. 153).

In all wards containing patients suffering from chronic diseases there is bound to be a large number of wheel-chairs. This question must obviously be borne in mind when considering the width of doors, lavatories, and corridors, the size of lifts and various treatment rooms, etc., to be used for wheel-chair patients. Trolley bays or special rooms easily accessible must therefore be made available for the storage of wheel-chairs. It would be very difficult to estimate anything like an exact percentage of chronic sick patients requiring wheel-chairs, but the proportion would be very considerable even allowing for the fact that they would not all be in use at the same time. Neglect to provide suitable storage accommodation would naturally result in unsightly and inconvenient crowding of the wards and corridors. Each wheel-chair requires 10½ sq. ft. of floor-space.

27

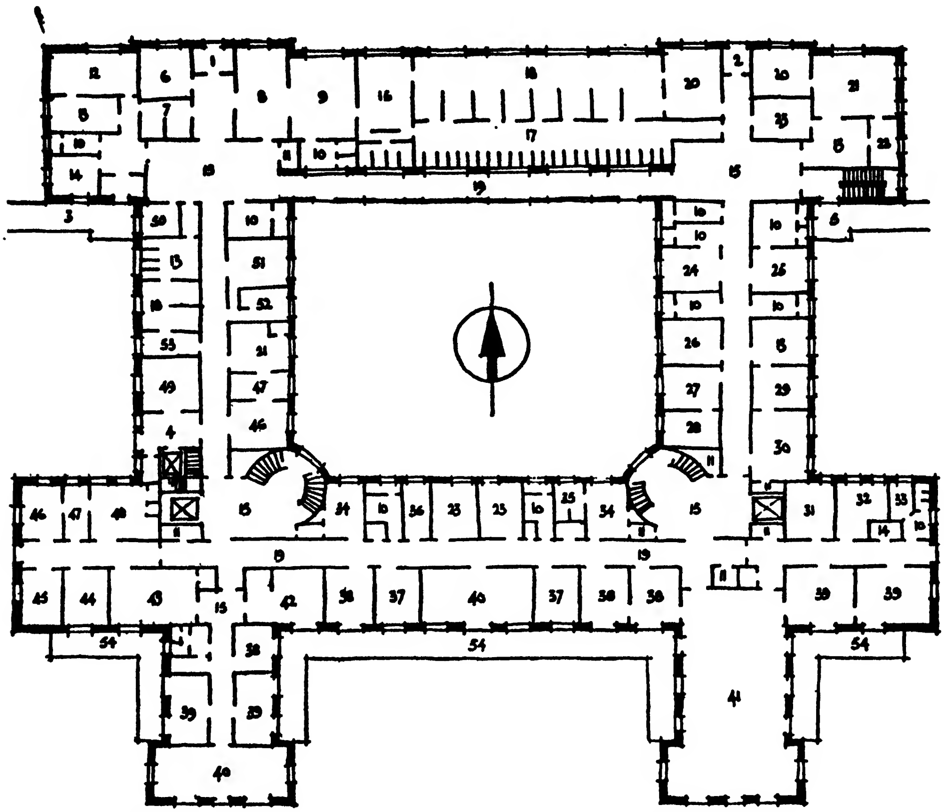
Maternity

AT THE Royal Sanitary Institute Congress held at Blackpool in 1934, the general opinion was divided between the superiority of a hospital compared with the home for child-birth. The first necessity appears to be, nevertheless, the guarding against the menace of infection, more especially the dreaded puerperal fever. The latter has lost many of its terrors through greater bacteriological knowledge and the invention of sulpha compounds and the discovery of penicillin.

The popularity of the hospital as the best place to be born in is evident by the fact that the increased application for beds has far exceeded the beds available. The increase has probably been largely due to the fact that hospitals have been giving special attention to the needs of the maternity patients, thereby increasing both their comfort and their safety. The normal mother does not need facilities greatly differing from those of any other patient. The normal new-born baby needs little beyond being kept warm, clean, properly fed, and permitted to sleep. But it is the care of the premature baby and the sick baby, and the protection of all from infection, that has made hospital to-day the safest place for the new-born baby.

Maternity accommodation may be planned either as a separate hospital or home or as a department of a general hospital. The Departmental Committee on Maternal Mortality and Morbidity, 1932, recommended that the latter arrangement should be followed when practicable in the interests of economy, as well as to facilitate specialist treatment of non-obstetric conditions associated with pregnancy and childbirth, and a similar opinion is expressed in The Report on an Investigation into Maternal Mortality issued by the Ministry of Health, 1937. There are, indeed, obvious advantages; for instance, economy in administration, facilities for medical or surgical consultation and treatment, and easy access to special departments for diagnosis and investigation such as the radio-diagnostic department and the laboratory service. The modern tendency is thus to regard a maternity department as an integral part of a general hospital, whether voluntary or municipal.

See Figs. 134 to 136, also 138 and 139, for plans of recently erected maternity wards and departments and Fig. 133 for an independent maternity home. Figs 140 to 142 indicate standard plans prepared by the Ministry of Health and Fig. 143 shows the cot unit adjacent to the maternity ward, while Fig. 137 is of a typical anti-natal unit.



1 ENTRANCE FOR PATIENTS
2 ENTRANCE FOR STUDENTS
3 COVERED WAY TO NURSES HOME
4 SUSPECT RECEIVING
5 SERVICE ENTRANCE
6 RECORD OFFICE
7 NEW PATIENTS
8 FRIENDS WAITING
9 PATIENTS WAITING
10 TOILET
11 STORE
12 ALMONER
13 WAITING
14 SISTER
15 HALL
16 URINE TESTING
17 DRESSING CUBICLES
18 EXAMINATION & TREATMENT
19 CORRIDOR
20 TREATMENT
21 EXAMINATION
22 WEIGHING
23 DOCTOR
24 FEMALE STUDENTS
25 MALE STUDENTS
26 DISTRICT NURSES
27 D.N. STOCK
28 D.N. PREP
29 MATRON'S CLERKS
30 MATRON
31 SLUICE
32 STERILIZING
33 PLASTER
34 KITCHEN
35 LARDER
36 MACKINTOSHES
37 SISTERS
38 1-BED WARD
39 2-BED WARD
40 4-BED WARD
41 12-BED WARD
42 NURSERY
43 WORK & SLUICE
44 LABOUR
45 FIRST STAGE
46 DELIVERY
47 STERILIZING
48 PREP & RECEIVING
49 SUSPECT EXAM & RECEIVING
50 PORTER
51 X-RAY
52 DARK
53 INTERVIEW
54 SOLARIUM

MATERNITY HOSPITAL
SIMPSON MEMORIAL MATERNITY PAVILION
ROYAL INFIRMARY · EDINBURGH

ARCHITECT: T. W. TURNBULL

FIG. 133.

PLANNING

When the maternity department is built as a part of a general hospital it should be planned as a separate block. If this is not practicable it should form a separate department distinct from the general medical and surgical wards and should have its own entrance.

In planning a maternity department, it should be borne in mind that the normal maternity patient is not a sick woman. She has undergone a good deal of physical discomfort and disability for some months and she has to pass through an exhausting and painful experience at parturition, but once that is over she rapidly recovers her strength. The atmosphere of a maternity ward should therefore be one of health rather than illness.

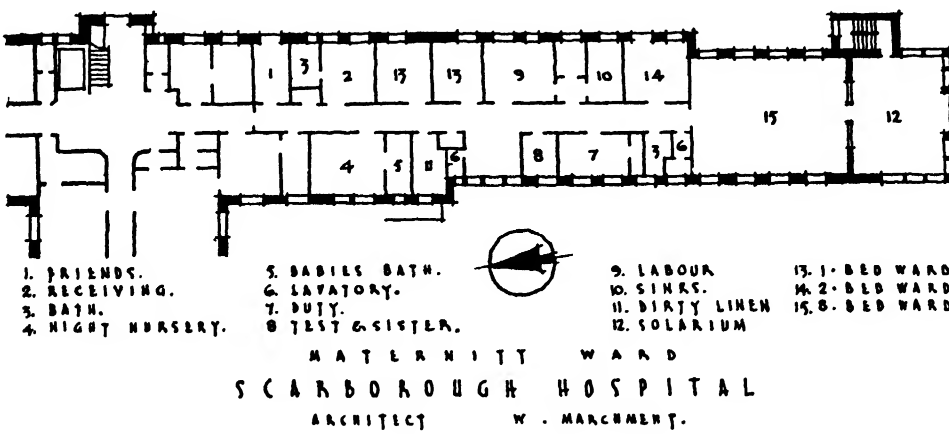


FIG. 134.

The Ministry of Health's Memorandum in regard to maternity hospitals and homes makes clear the class of patient for whom the provision should be made, namely:

- *a* all abnormal cases
- *b* all normal cases in unsatisfactory home environment
- *c* all abnormal ante-natal cases
- *d* any beds available after these three categories have been provided for, should be used for primiparae or other normal cases who are willing to pay at least a proportion of the cost.

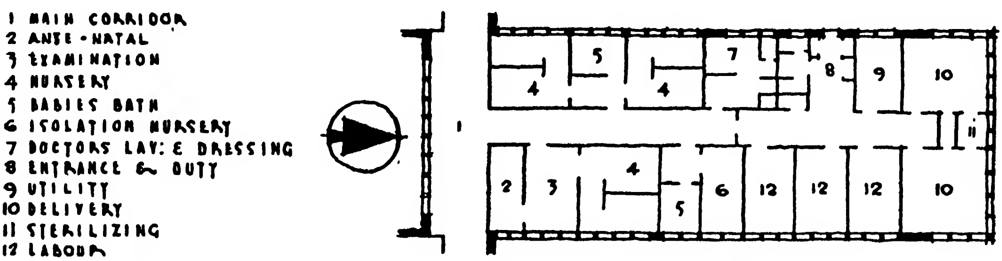
The Memorandum further states the department should be provided for the purpose of dealing with all non-septic cases.

The size of the department is a matter of some importance, as its efficiency largely depends on the perfect co-ordination of the different sections: ante-natal, natal, and post-natal, and largely also on the constant individual supervision by doctors and nurses of long experience. In very large units the essential co-ordination and personal

supervision is apt to break down, and mistakes may more readily occur which pave the way to difficult labour and death.

A department should consist of self-contained lying-in accommodation complete with labour unit and all accessories. It is desirable to have an accessory labour unit and, where there are more than sixteen beds, two fully equipped labour units will always be required. The question of the actual size of the department is difficult to lay down. If the principle adopted in some hospitals, of vacating each ward in turn, is carried out, it will obviously be necessary to make larger provision than if this is not done.

The Report considers that thirty beds should be the maximum number under the charge of one sister for a lying-in ward unit, and while a smaller number might be convenient it should be borne in mind that smaller units lead to a multiplication of ancillary rooms and consequently to a higher cost. Thirty beds should not be too many for one sister, provided she has sufficient trained staff for the proper supervision of the



MATERNITY DEPARTMENT.
FRANKLIN D. ROOSEVELT HOSPITAL · BREMERTON · WASHINGTON · U.S.A.
ARCHITECTS: J. A. NACAMORE, G. GRAINGER, C. J. BRADY, & P. B. JOHNSON

FIG. 135.

work in the wards and the nurseries and is not responsible for other duties, such as those in the labour unit and ante-natal unit. A maternity department would therefore contain two lying-in ward units not exceeding thirty beds each. The total in-patient accommodation will therefore be as follows:

a	ordinary lying-in beds	60
b	segregation accommodation	
	(i) potentially septic	2 to 4, or more according to the nature and practice of the hospital
	(ii) observation	4
c	ante-natal beds	10
	Total	76 or more

The danger to the lying-in women of septic infection and the ease with which such infection may be introduced into the wards or conveyed from one patient to

another make it essential to adopt special precautions in order to reduce the risk of infection to a minimum. The most important precautions lie in the realm of administration and treatment rather than that of planning and construction, but planning can contribute materially to safety. Its aim should be to provide the conditions that facilitate good administration and treatment and tend to restrict the effects of infection, should this unfortunately occur.

Provision must be made for the nursing and treatment of the abnormal or complicated case, for dealing with the apparently straightforward confinement which suddenly exhibits a dangerous abnormality, and for the immediate and easy separation of any patient who is suspected of being a danger to others.

It is an open question whether the risk of the spread of infection in a maternity

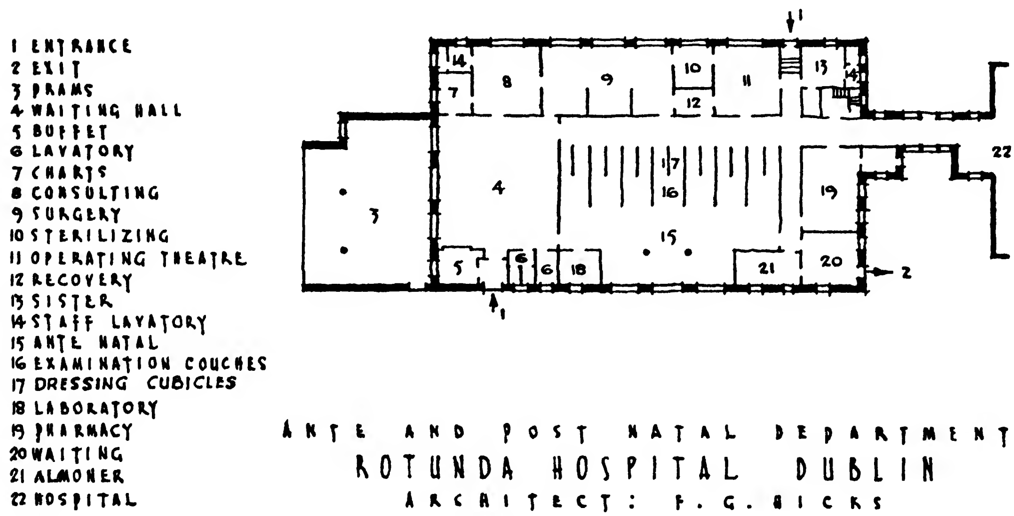


FIG. 136.

department necessitates the provision of separate residential accommodation for the nursing staff. Nurses may act as carriers of infection, and therefore the less midwifery nurses associate with other persons who may be in contact with septic infection the better and safer for their patients. It is particularly undesirable that maternity nurses should come into association with those employed in nursing cases of sepsis, and especially of puerperal sepsis. This is difficult to avoid where maternity nurses are housed in the nurses' home of a general hospital in which cases of puerperal sepsis or other acute forms of sepsis are treated. Moreover, midwifery work involves irregular hours, and the midwives need special consideration in regard to meals, rest, etc. For these reasons it is sometimes held that separate quarters should be provided for the nurses and pupil midwives employed in the maternity department of a general hospital. On the other hand, the risk is often regarded as negligible if proper precautions are taken, and there is obvious convenience in housing all the nursing staff

of a hospital in one nurses' home: and whatever is done they will consort together outside the hospital.

ACCOMMODATION

Ante-natal Unit. It may form a separate part of a general out-patients department or, preferably, be a part of the maternity department itself.

This unit has been fully reviewed in Chapter 15 (see also Figs. 136 and 137).

The Departmental Committee on Maternal Mortality and Morbidity suggested the provision of ante-natal beds in association with the lying-in beds, and it is now usual to provide ten beds for ante-natal purposes in addition to the sixty lying-in beds. If at any time the number is insufficient, use can be made of some of the single-bed wards in the lying-in ward units for suitable ante-natal patients. The ante-natal beds might be in one ward, although one or two single-bed wards are desirable.

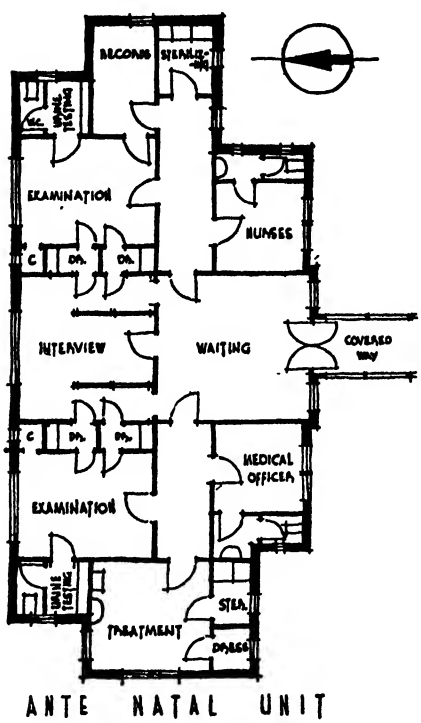


FIG. 137.

Receiving Unit. All patients who are unrecorded and of unknown condition are a potential source of infection, and therefore, to obviate risk of infection in the general first stage and labour-rooms, they are taken to an isolation-room at the entrance, with access thereto by a vestibule leading to the outside of the building. This room is fully equipped for treatment only or as a labour unit.

Ante-natal patients suffering from venereal disease should always receive treatment in rooms placed near the entrance. When the number of potentially septic cases is sufficient to warrant the provision of a special unit for them, it is desirable to provide a separate preparation room for them, either in the receiving unit or in a segregation unit.

The provision of a receiving unit for "booked" patients is desirable, and as it should have a separate entrance and be in convenient relation to the labour unit, it is often incorporated en suite. The accommodation should include a small waiting-room in which the patient and her friends are received and two preparation rooms of 150 sq. ft. each. A bathroom and W.C. should adjoin the preparation rooms.

Segregation Unit. From the receiving unit, cases suspected of sepsis are taken to segregation wards. The segregation (or separation) ward, one to each unit of fifteen beds, must

have its own sluice and preferably separate sanitary accommodation. If more than one bed is in a ward, each bed must be divided by a permanent screen.

There are three types of patient unsuitable for admission to and retention in the ordinary lying-in ward:

a the "potentially septic," i.e. emergency cases admitted in labour without having previously attended the ante-natal unit and patients who are regarded as specially liable to develop sepsis on account of internal examination or attempted delivery before admission;

b patients who develop signs suggestive of sepsis after delivery;

c patients with definite puerperal sepsis.

Potentially septic patients should not come into contact with other patients, and should therefore be admitted to single-bed wards. In many hospitals the great majority of the admissions are booked cases who have attended the hospital ante-natal unit and are admitted immediately after the onset of labour. Where this practice prevails, the provision of single-bed wards as part of the lying-in ward units should afford all the segregation necessary for emergency admissions, and proper nursing technique should be an efficient safeguard against spread of infection. Where, on the other hand, the proportion of potentially septic cases is large, a special unit should be provided for them, containing a delivery room with sterilising recess, a sufficient number of single-bed wards, a duty-room, and sanitary provision including sluice-room. If possible, this unit should be on the ground floor with a separate entrance. Special attention should be paid to the ventilation of the wards, and facilities for placing the beds in the open air should be available when practicable.

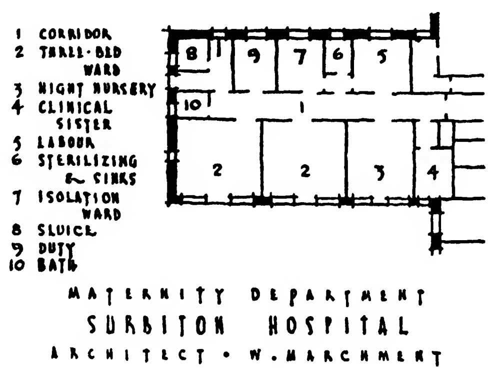


FIG. 138.

After delivery, a patient may develop pyrexia or other signs suggestive of sepsis. Pending a definite diagnosis, such a patient should be transferred to a single-bed ward for observation; for such temporary separation it is useful to have, say, four single-bed wards grouped together and provided with their own duty-room and sanitary accommodation, including sluice-room. The special observation unit may not be necessary when the maternity department forms part of a general hospital, for in such circumstances mild cases could be sufficiently segregated in the ordinary single-bed wards and the more serious could be removed to the isolation department of the associated general hospital.

A patient who becomes definitely infected with puerperal sepsis should be transferred at once to isolation accommodation outside the maternity department. This may be in

a special unit for puerperal sepsis, or in the ordinary isolation department of the general hospital, or alternatively it may be provided in an isolation hospital to which cases with puerperal are admitted. The wards need not differ from the usual type of single wards provided in the so-called cubicle unit of an isolation hospital (see Chapter 34), but a room for obstetric examination and treatment is desirable. The importance of open-air treatment and sunshine in the treatment of puerperal infection is generally accepted. When the accommodation is to be adjacent to the maternity department it will normally be connected to it by a covered way with open sides. Separate living accommodation for the nursing staff engaged in this unit is desirable. This special isolation unit should have at least two single wards and should preferably have a veranda.

In large schemes separate labour units with their ancillary rooms adjacent are required, and these too are isolated from the segregation wards.

The British Paediatric Association consider that with an infant population of seventy-

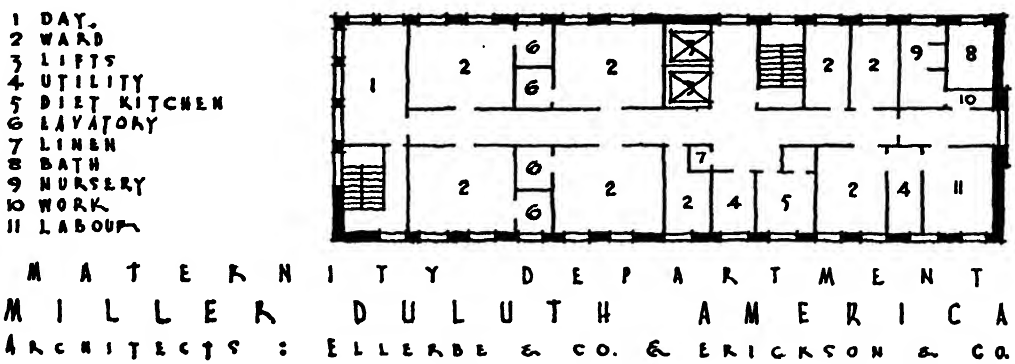


FIG. 139.

five a sick nursery of ten to fifteen cots would probably be required. The cots should be isolated in cubicles with glass screens on to a corridor and be air-conditioned. There should be a wash-hand basin in each cubicle; arrangements for darkening the cubicle when necessary and a piped-oxygen supply are an added advantage.

Lying-in Wards. Normally small lying-in wards, of up to six beds are provided, with separate single-bed wards. In The Report of the Ministry of Health's Investigation into Maternal Mortality, 1937, the following statement is made on the subject: "Lying-in wards should contain a small number of beds (preferably not more than four). The wards should provide adequate floor space, be well-lighted, suitably heated and have an abundance of fresh air. Whenever practicable they should be cross-ventilated. A sufficiency of single-bed wards is essential."

These wards cannot be planned with windows on both sides, except at great expense, nevertheless there should always be cross-ventilation to a well-ventilated corridor. The corridor type of layout is therefore suitable for this type of department. For the convenience of the nursing staff and as a means of shortening the length of the ward

unit, the London County Council has adopted a cruciform-shaped unit, the cross-way section containing one six-bed lying-in ward, a nursery for twelve babies, and two six-bed wards in the long sections. A sun balcony, babies' bathroom, sink-room, urine-testing room, and subsidiary sanitary annexe, the latter approached by a lobby, complete the unit.

Special attention should be given to good lighting and ventilation, and in addition to fanlights over doors for lighting and ventilation, windows giving observation into the wards from the corridor are useful to facilitate supervision. A covered terrace or veranda on to which beds can be wheeled is a useful feature, but may be unnecessary if widely opening windows are provided.

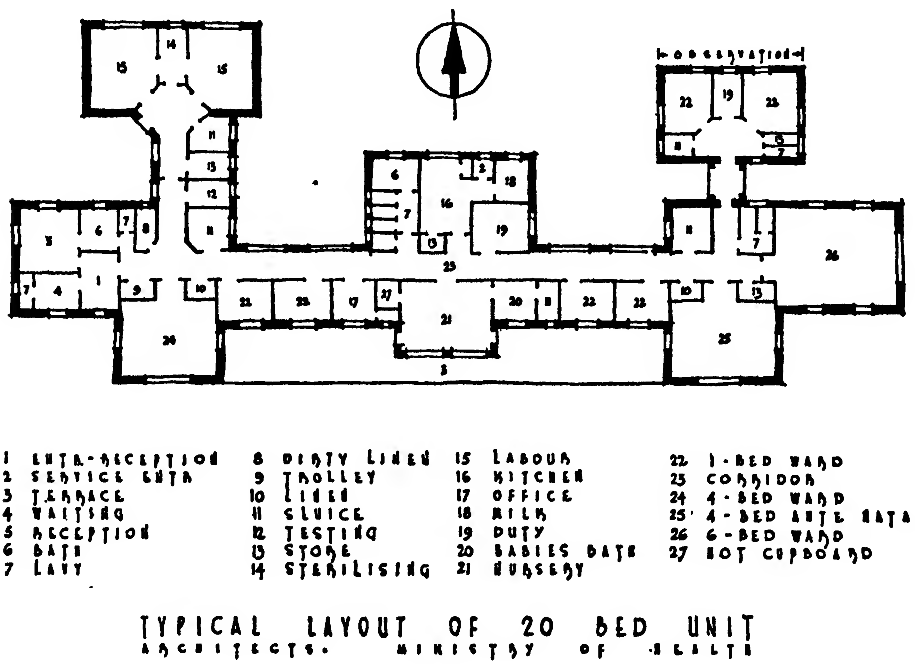


FIG. 140.

The British Paediatric Association is of the opinion that each mother should be in a separate cubicle or room large enough to accommodate her and her child. For convenience in administration they state the cubicles should be grouped into wards of eight to twenty and the walls between adjacent cubicles should be glass in order that patients will not feel isolated. Babies will receive all necessary attention, e.g. bathing, clothing, and feeding in the cubicles, and there would need to be in each cubicle adequate provision of equipment for the nursing care of the child—for instance, bath, immersion and low-reading clinical thermometers, hot rails, trolleys, cupboards, weighing scales, closed receptacles for soiled napkins, etc. Extra accommodation will be necessary for certain babies who for various reasons may require to be removed from

their mother's room, e.g. crying infants, and so forth. Accommodation for such infants would, of course, be of the cubicle type.

The area of ward per bed space is recognised as 96 sq. ft. for mothers and infants. It may be better to describe the space as 10′ by 10′ if the cot is put at the side, but 8′ by 12′ will serve if the cot is put at the end of the bed. No reduction in the area per bed in lying-in wards will be made even if the baby is removed at night. Likewise the space for ante-natal cases should also be 96 sq. ft., as many of them will be abnormal.

Single-bed wards should have an area of 120 sq. ft. and minimum height of 9′.

Premature Wards. A premature baby can be properly cared for in a special heated or air-conditioned crib, but if the department is large enough to justify it, it is simpler

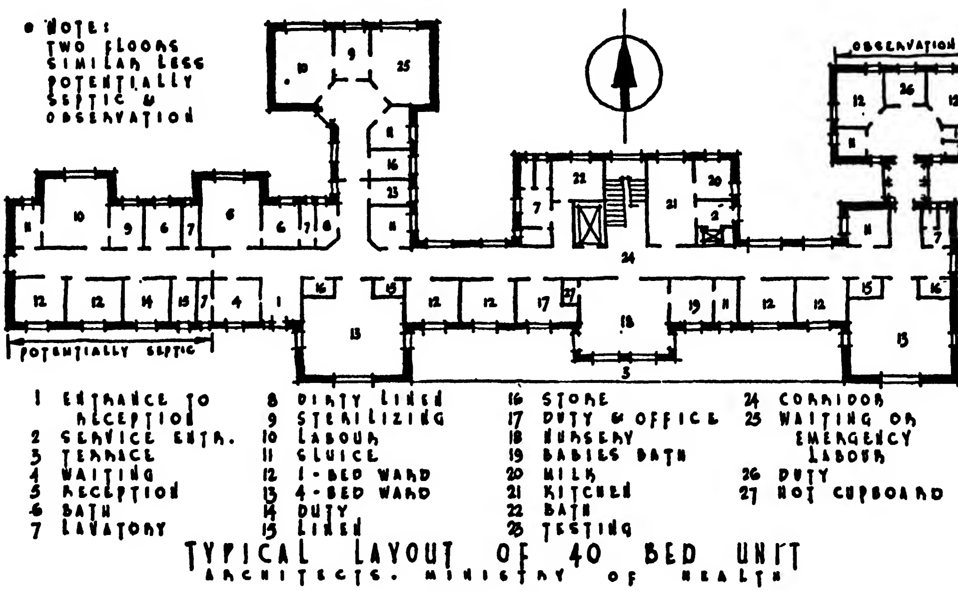


FIG. 141.

and more effective to provide a separate nursery unit for prematures, since it has been shown that high temperature and high humidity greatly reduce both morbidity and mortality among premature babies.

The number of cubicles will depend upon the type of obstetrical work done. In some maternity hospitals which deal with a relatively high proportion of abnormal cases, the prematures may be 10 to 20 per cent. of the total infants; in hospitals which accept a higher proportion of normal cases, the premature cubicles will be 5 to 10 per cent.

Some of the cots provided should be of a special type.

Ancillary Rooms. The rooms given for an ordinary ward unit in Chapter 18 will be provided in a lying-in ward unit, with the addition of a second sluice- or sterile-room. The sterilisation of bed pans after use is essential in a lying-in ward unit, and sluice-rooms require space for the apparatus necessary for that purpose as well as other

fittings, such as a gas incinerator and water and utensil sterilisers. The amount of soiled linen in a maternity department is heavy, and proper provision for its temporary storage and prompt removal should be made. Provision for the incineration of soiled dressings and other waste products is necessary, but it is usually preferable for this to be carried out elsewhere than in the department. All mattresses are disinfected before being used by another patient, and therefore a mattress chute should be incorporated in the sluice-room. The chute can be constructed of 4′ dia. spun-concrete water pipes (see Chapter 36).

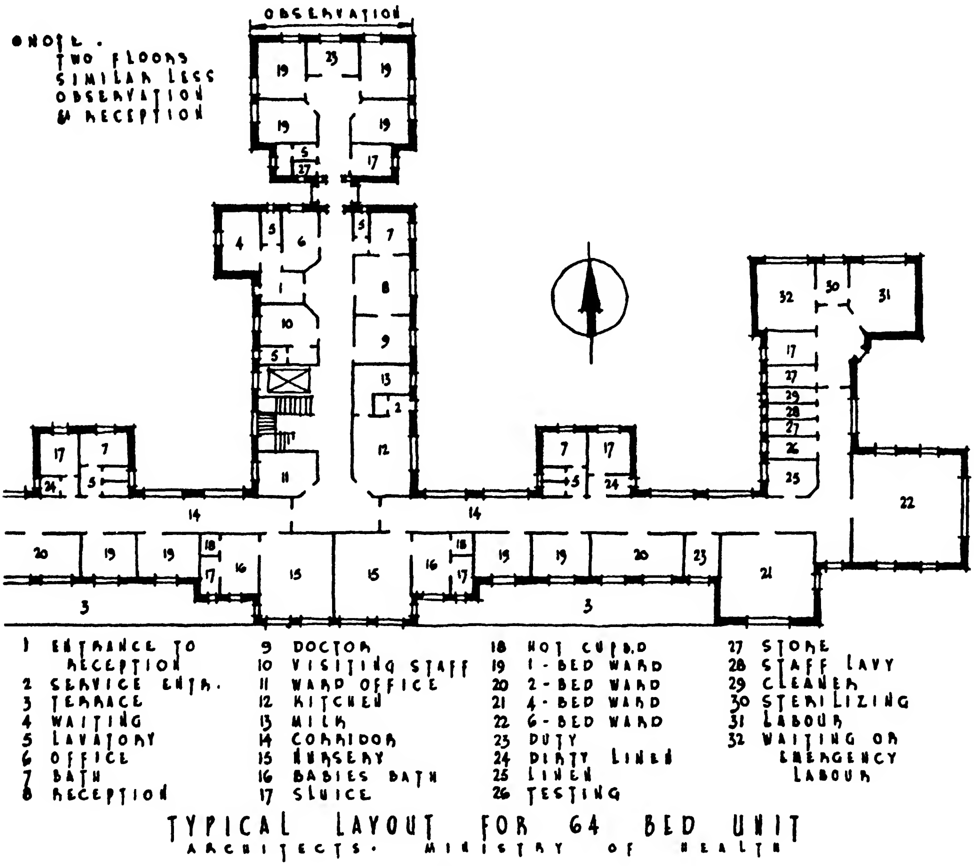


FIG. 142.

A special milk food preparation room is not always considered necessary, as the majority of the babies are breast-fed. When not provided, the provision of refrigerating apparatus in or adjacent to the ward kitchen for the storage of milk for the mothers is required. Laboratory facilities should be available near the lying-in wards.

It is not desirable for patients and visitors together to use the lighted recess of the ward unit, when this is used as a day-room, for a number of these visitors will be men. A small additional waiting-room should be provided, and should be tastefully furnished with settees, etc., for the use of waiting relatives.

Labour Unit. This may be concentrated in a single unit, containing four first-stage rooms and four labour-rooms, with a sterilising-room and a sluice-room, to serve the two lying-in ward units, or a labour suite consisting of two or three first-stage rooms, two labour rooms, a sterilising-room and a sluice-room may be provided in association with each ward unit. The former arrangement is undoubtedly the more economical, and is regarded as the better on administrative grounds; with a centralised unit a sister's office will be provided, but if each ward unit has its own labour suite this need not include a sister's office.

The labour unit should be self-contained and shut off to some extent from the lying-in section of the department, and be approached either by an inner corridor or divided by double sound-proof doors.

The Ministry of Health and London County Council recommended that one labour room be provided to every fifteen or sixteen beds. If first-stage rooms are provided the number of actual labour-rooms can of course, be reduced. The first-stage ward may accommodate up to three beds and the proportion of beds in first-stage room to delivery-room is three to two.

The labour-rooms are economical when grouped in pairs with sluice- and sterilising-rooms common to each pair. In large schemes they should be planned for sections being closed when found necessary, while the other proportion is available for duty, without undue inconvenience. A students' gallery should be provided to some of the labour rooms, with separate access from the corridor.

The size of the labour-rooms depends on whether they are required to accommodate only the patient, with the doctor and midwife, or whether students and pupil midwives will also be present. An oblong-shaped room 14′ by 18′ for the former is usually suitable and it should be well lighted, preferably from the north, and well ventilated. First-stage rooms should be 80 to 100 sq. ft. in size, and the sterilising-room, sluice-room, and sister's office should be approximately 100 sq. ft. each. The height of the labour-rooms should not be less than 10′, but that of the other rooms may be less. A temperature of 60 to 70 deg. F. is desirable.

A small "shadowless" lamp is often provided together with emergency lighting plant of a similar type to that fitted in operating theatres, but on a smaller scale. This plant should also allow for one point in sterilising-room and anaesthetic room or lobby, if provided.

The unit should be equipped with gas and air analgesia apparatus.

The sterilising and sluice-room should be adequate in size and should be in convenient proximity to the delivery-room. The layout of this room requires careful consideration, and in particular the circulation of clean and dirty instruments must be considered and a one-way system evolved. The temperature of water must be thermostatically controlled.

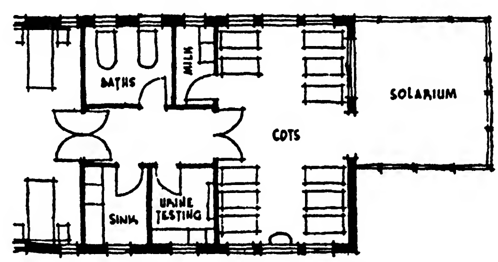
The London County Council advocate the provision of a babies' bathroom adjacent to the delivery-rooms for the babies' first bath.

A fully equipped operating theatre suite, for gynaecological cases only, may form

either a part of the gynaecological unit of the out-patients department or be incorporated in the maternity department. This theatre will also require a students' gallery with separate access from the corridor. In small maternity departments one of the labour-rooms should be made somewhat larger and fitted as a theatre.

The design and finishings of these rooms are similar to those described for the operating department and its ancillaries (see Chapter 24), but special attention is necessary to the sound insulation problem between labour-rooms, e.g. double windows, and the use of noise-absorbing materials in the construction of walls and ceilings to prevent disturbance to patients emanating from this unit is essential.

Nursery. Opinion is divided on the advisability of providing a separate nursery for babies; nevertheless it is generally accepted that it is desirable in order to ensure adequate rest for the patients in the lying-in wards by the removal of fretful babies at night. There is something to be said for both systems; some authorities are of the opinion that whilst a mother is away from a private house and is being looked after by a midwife, she does not learn as much baby craft as in her own home. Against this must be set the fact that the birth of a child in a hospital gives many women their only holiday, and the mere proximity of a baby is not in itself any help in learning baby craft.



MATERNITY WARD TYPICAL LAYOUT

FIG. 143.

In calculating the size the London County Council practice is to allow an area of 25 sq. ft. on 80 per cent. of the number of adult beds, but The Report suggests the same number of cots as lying-in beds.

The cots are placed in the centre of the room with incubator and isolation rooms adjoining for sick babies. Adjacent, usually on the opposite side of corridor, provision must be made for milk preparation, washing napkins, etc. This arrangement of the nursery in the centre divides the ward floor into two units, and if isolation becomes necessary, one section only need be closed.

Opening off the nursery or in some cases incorporated in it is the bath and changing-room for the infants. The bath-tubs are specially designed without projecting taps or sharp edges, because any slight carelessness on the part of the nurse might result in serious damage to the soft and frail bones of an infant. These baths are placed at a convenient height (2′ 2″ to 2′ 6″) for the nurse, so that she does not have to stoop unnecessarily, and are provided with a small fireclay slab at the side fitted with powder bowls, etc. The provision of a sun balcony or solarium conveniently situated is essential.

Laundry. However small the department is, it should have means of carrying out some of the laundering on the spot, though it may be preferred to have the main part of the

laundering done elsewhere. The daily return of napkins and garments is necessary, and therefore a small hand laundry is required in the maternity department together with sterilising facilities.

Equipment. The requirements of a maternity department are similar to those for the general medical wards, with certain additions:

- *a* bedpans for this department should be sterilised, in which case a separate numbered bedpàn is unnecessary; the modern type of automatic bedpan washer should be installed, together with steam for sterilisation of the bedpans;
- *b* in addition to the bedpan sink and ordinary sink, a slop sink for disposal of foul matter is necessary and also an incinerator; a hygienic slop pail for soiled diapers is also necessary;
- *c* beds and cots: there are two types, one with cot attachment at the foot and the other at the side. The dimensions of these cots or bassinets are 3′ by 1′ 7″ wide by 3′ high; the consensus of opinion is that the side attachment is preferable;
- *d* labour beds: these must be provided with rubber mattress in lieu of hair-stuffed mattress.

PLATE XLIII. Children's Ward
Great Ormond Street Hospital for Children, London

PLATE XLIV. Children's Ward
Isolation Hospital, Paisley

[*To face page* 250

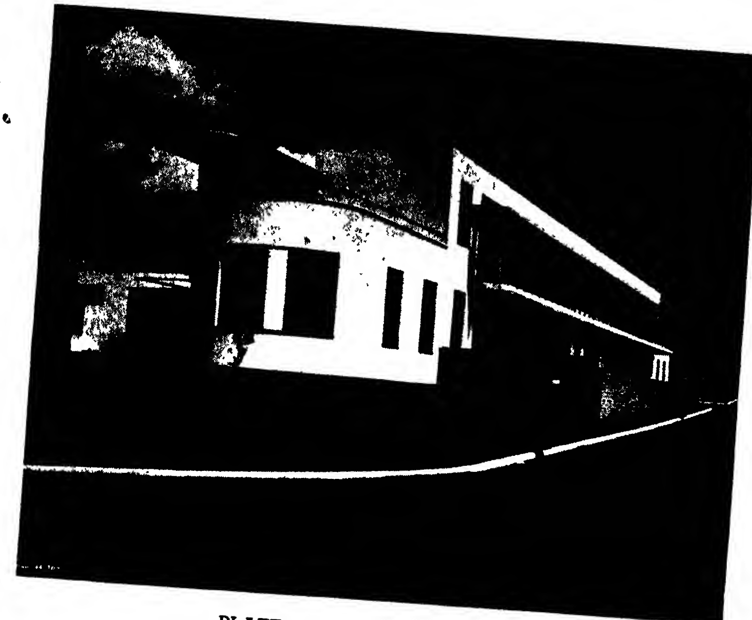


PLATE XLV. Cubicle Pavilion
Isolation Hospital, Paisley

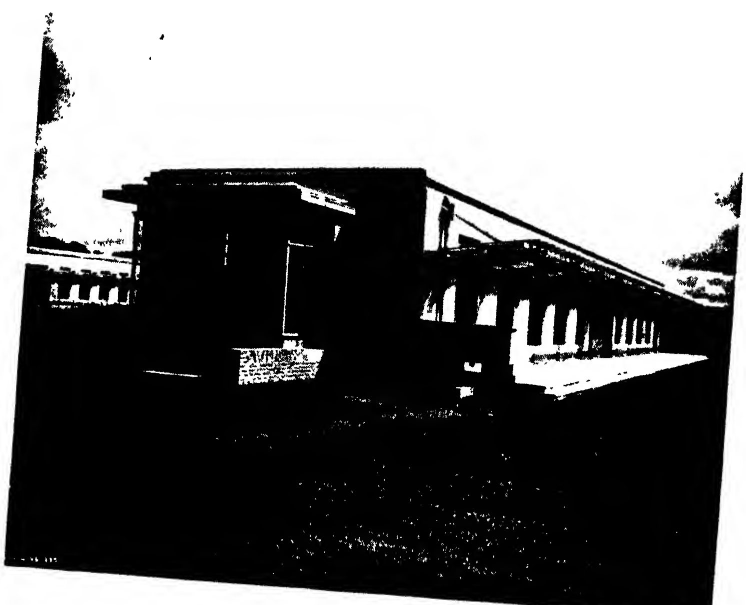


PLATE XLVI. General Pavilion
Isolation Hospital, Paisley

To face page 251]

28

Paediatric

AT PRESENT local services are doing a great deal to look after the health and good progress of children during their earliest years. By means of pre-natal clinics, maternity hospitals, infant and child welfare centres, and free-milk schemes, the State has assumed a very large responsibility for children whose parents are not in a position to provide all the care that is needed. Logically this superintendence, once begun, must be continued by placing children in hospital when need arises.

The necessity of separate hospitals for children, or at least ward units, has long been agreed. Apart from other considerations, children are less restrained than adults in voicing discomfort and suffering and they are more noisy in convalescence, and therefore likely to be a disturbing element in a general ward. Hospital care of infants and children deserves careful planning to relate it to modern standards. Children not only need protection from cross-infections, but, from a psychological standpoint, they need to be in the company of other children and in surroundings as cheerful and homelike as hospital conditions will permit.

Children present a peculiar problem, forming as they do a special type of patient, subject, however, to diseases of every kind and of every part of the body. There should be a paediatrician attached to every maternity department. In addition, it may very often be advantageous to have children's wards provided in one hospital of a group of three or four, when geographical conditions make this possible. Probably, however, the best arrangement of all is a hospital for children only, with its special departments for diseases of different regions, and a hospital-school attached to it for long-stay cases in the country.

PLANNING

In smaller hospitals it has been the custom to make no special provision for the care of children, but to use what wards are available when the need arises. In larger hospitals there are usually open wards for children and perhaps one or more wards for observation or isolation purposes. Little thought has been given to grouping the children according to age and condition or to the arrangement of a service-room to facilitate nursing care.

In order to guard against all possibility of infection by newly admitted children it would be necessary to isolate them for twenty-one days; this would be a policy of perfection that it would be impracticable to attain without the addition of a large

quarantine block in every hospital. Suspects or known contacts should certainly be isolated in an observation ward.

The British Paediatric Association consider all admissions should be admitted to a single-bed ward for at least 48 hours or until such time as declared free from infection. Only after negative bacteriological reports have been received should the child be admitted to an open ward. The practical difficulty in adopting this procedure is that the admission wards may form a bottleneck unless there are an adequate number. They estimate that for an open ward of twenty cots there should be not less than four admission cubicles, but if isolation cubicles are available for ward nursing, then the number of admission cubicles may be reduced.

At a discussion on cross-infection of wards held by the Royal Society of Medicine in 1942 it was suggested that an admission ward with cubicles in which each child spent the first 48 hours be provided, and that ward units should consist of six to eight cots, with a number of cubicles in which infectious children should be nursed. Such an arrangement now exists in Great Ormond Street Hospital for Children, London.

The question of age in planning wards can be considered. The British Paediatric Association do not consider it necessary, but the London County Council practice is:

a the limit of age for boys in a mixed children's or girls' ward should be 5 years, although in special cases the age might be extended to 7 years;

b it is undesirable for boys to be admitted to men's wards before the age of 16 years, though of course it may be inevitable; there is, however, no objection to girls of any age being admitted to women's wards, except that if one child alone were accommodated in a women's ward she would probably suffer from loneliness;

c the provision of separate boys' wards would, of course, depend on the size of the hospital, but the same object can be obtained in smaller hospitals by means of either fixed or movable screens in the larger ward.

It is desirable that acutely sick children should be guarded against undue noise from other children, e.g. those who are recovering and are using the day-room.

The treatment of children should be on open-air lines to the greatest possible extent. For this reason the arrangement of the children's department of a general hospital on the top floor of a normal ward block is desirable, thereby rendering the use of the flat roof available for open-air treatment and securing more light in the wards. Wherever the department is situated it must be in a quiet area oriented with the main axis north and south, thus permitting east and west exposure in the patients' wards, with the playroom and terrace at the south end. Space for sun bathing and outdoor play should be provided in a sun porch and connecting open terrace fenced to a height to provide for safety. The importance of balcony space is stressed for its virtues for nursing sick children.

With regard to crippled children or those suffering from chronic ailments which yield only to prolonged treatment, these should be and usually are accommodated in

special hospitals, away from the big towns, where educational and training facilities are provided. For this same reason playroom accommodation is not necessary to any great extent in town hospitals, as children should be transferred to a convalescent hospital as soon as they are well enough to go.

One of the principal advantages of the longitudinal type of layout is for use in children's wards. The nursing units can be sub-divided into completely independent half-units, and then if measles break out in one-half, only that half portion need be segregated.

A further point to consider in ward planning is that in the case of babies the admission of the mother may be desirable, so that breast-feeding can be maintained, in itself

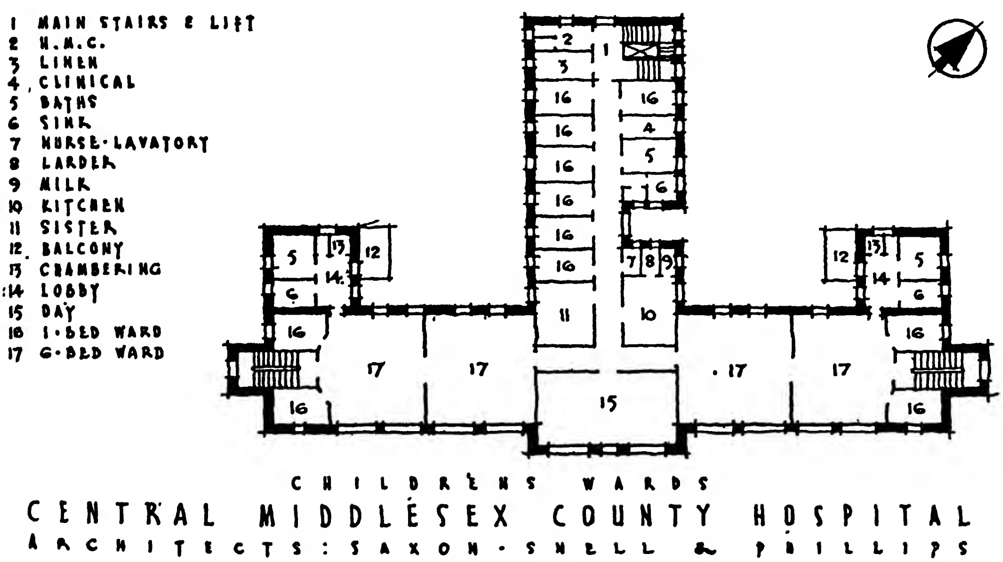


FIG. 144.

a most valuable anti-infective measure. Common-room and sleeping accommodation should, therefore, be provided for this purpose.

See Figs. 144 and 146 for recent examples of planning.

ACCOMMODATION

Ward Unit. It is sometimes held that in the interests of elasticity the provision of specialised accommodation suitable for one class of patient should, in a general hospital, be restricted as much as possible, and that in conformity with this principle wards primarily intended for children should be of the same dimensions as those for adult wards. Great fluctuations occur, however, in the admission to children's wards, and the number of wards with dimensions suitable only for children should be kept down to the number likely to be constantly required for that purpose.

As infants are susceptible to certain infections, such as respiratory and intestinal, children under 2 years of age should as a general rule be nursed in single wards. For this reason and also to permit of immediate segregation of children showing any signs or symptoms suggesting that they may be a source of infection, the number of single wards should be liberal. It must be remembered that direct infection from ward dust, and droplet infection from other children can only be prevented by nursing infants in closed cubicles. Other wards for children should not contain more than eight beds, and it is preferable that the number should be restricted to six or even four.

It will be appreciated that, from the air-borne infection angle, isolation of children in separate rooms must decrease cross-infection. It is on this basis that the sub-division of wards by various types of "cubicles" has been devised. The open ward, however,

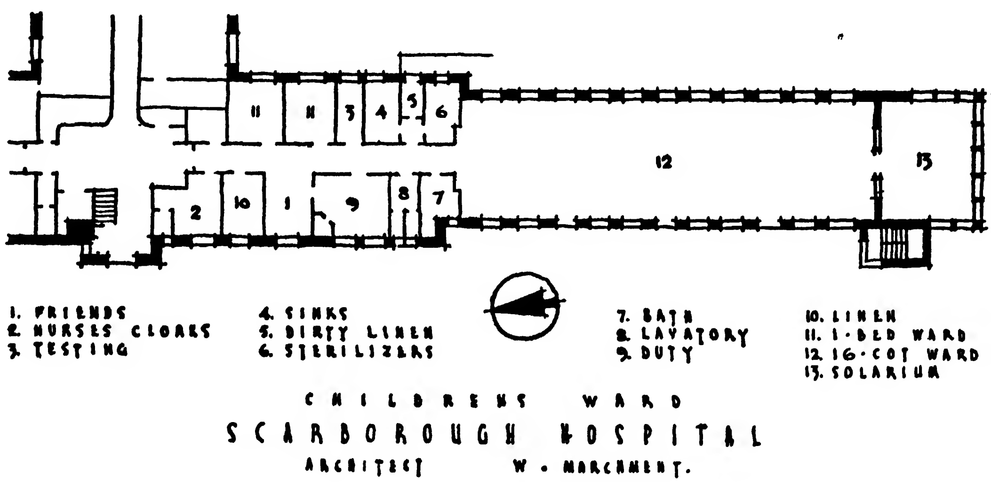


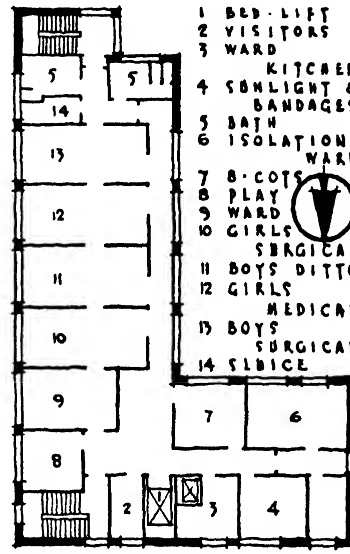
FIG. 145.

has certain merits. Children are able to talk and play together, supervision is very much easier, and teaching of students is pleasanter and more practical. In planning a children's ward the aim should be to produce a unit which is designed to reduce cross-infection to a minimum, and which at the same time, is practicable to work, and to preserve for the child and nursing staff something of the homely, happy atmosphere of the open ward without its attendant dangers. Children, even babies, dislike being by themselves.

The policy of conversion of the ward into isolation units by dividing it into two rooms by glass rooms (technically called "cells," and often erroneously referred to as "cubicles") with a central service corridor is not entirely satisfactory. The reason for failure is the difficulty in preventing the corridor atmosphere from being a source of infection. In the wards of the Children's Hospital at Vienna, there are two rows of glass cells on either side of a central corridor. Each cell has a door opening on to the side corridors, which are used exclusively by the doctors and nurses, while

the central corridor, from which there are no openings into the cells, is used by visitors.

Cells should be made of glass walls above a solid dado: glass allows children to see their neighbours and thus reduces their sense of loneliness, and of course, allows easier nursing supervision. Each cell must have good daylight, ventilation, and heating. Its size must be such that a bed or cot can be moved in and out easily, that there is plenty of room for all nursing attention and for minor operative procedures, e.g. lumbar puncture. Cubicle planning means ward division by partitions not reaching the ceiling, and varying from 7′ to 9′ in height. These are not satisfactory and are little better than no partitions, and may be dangerous in giving a sense of false security. The actual isolation cells needed per ward unit will vary with the type and age of case admitted, but as a rough guide from two cells for an eight-bedded unit to ten cells for a twenty-five bedded unit, is adequate. A fourteen bed unit probably contains the smallest number of beds for which a complete unit is practicable in most instances. The maximum of thirty beds is somewhat below that allowed for an adult unit because of the proportionately greater nursing time required in caring for infants and children. If the average daily child census is less than fourteen, an adequate number of rooms should be kept available for segregating children from adults, but common service rooms must of necessity be used. The Report states that whilst it is agreed that children require more supervision than adults in a ward, it is considered that thirty beds is a suitable standard for the average self-contained nursing unit under the charge of one sister.



CHILDRENS·WARDS
GERMAN HOSPITAL
· LONDON ·
ARCHITECTS: SIR. J. BURNET, TAIT & LORNE

FIG. 146.

One of the most recent blocks erected is at the Great Ormond Street Hospital for Children, London. Here, on each floor there are thirty-six beds in six to eight-bed wards, six in two-bed wards, and nine in single rooms.

The London County Council have devised a plan comprising a straight twelve-bed ward, 22′ wide, bisected by glazed partitions, with six beds a side and opening out on the south-east end to a solarium and a subsidiary sanitary annexe containing sink-room, bedpan cupboards, etc., and space for foul linen and dustbin. The other end of the ward opens on to a central corridor, on each side of which are conveniently grouped four single-bed cubicle wards, two isolation wards, sister's room, blanket-drying room, patients' lavatory and bathroom, sink-room, staff lavatory in one wing and linen-room in the other; ward kitchen with larder and refrigerator cabinet; storage for ward furniture such as trolley, stretcher, and store

cupboards, day and dining-rooms (both on the south side). Each main ward, including cubicle and isolation wards and the day-room, open through french windows, to a terrace on to which beds can be wheeled.

The wards should face south or south-east, and be provided with a veranda or balcony with french windows opening upon it, so that cots can be wheeled out.

The wall or bed space allowed is usually 7′ to 8′ centre to centre; this is subject to there being ample provision for separation or sub-division of main wards by screens or partitions. The British Paediatric Association consider that at least 9′ centre to centre is required, as this goes a long way to reduce droplet infection from case to case. The width of ward should be 22′ and height 10′, except for small wards, which can be 9′ high if structionally convenient.

Nurses should "scrub-up" before and after attending to the toilet of the mouth or anus of any child as they would where "doing a dressing," therefore ample washing facilities must be provided for this purpose. A separate gown should be worn by the nurse for each patient, and after use it should be placed on a peg or stand. Ideally every cell should be provided with its own wash-basin, but in the interests of economy these may have to be situated in the corridor, and one basin may have to serve for more than one cell.

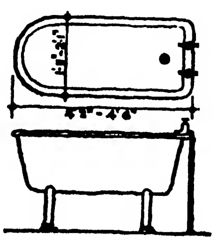


FIG. 147.

The cheerfulness of the children's wards is greatly enhanced by lining the walls with pictures of nursery-rhyme subjects—suitable to the age of the occupants—or other subjects of juvenile appeal. These dados, constructed in glazed tiles, are desirable if only because children will, if left with pen or pencil, use plastered walls as drawing-boards. At the Kent and Canterbury Hospital gay glass panels are provided to some of the windows.

Ancillary Rooms. The requirements are broadly the same as in the case of adult wards (see Chapter 18), but the needs of children call for certain variations in accommodation and equipment. More baths are required than in adult wards. It is useful to provide a fixed bath in each of the single-bed wards to be used for infants, as the advantages of treatment in a single-bed ward are diminished if the infant has to be taken elsewhere for washing or changing. These baths can also be used by the surgeon and nurse for washing their hands. Ward units where fixed baths are not provided in the single-bed wards should contain two bathrooms. The baths or bath tubs are specially designed without projecting taps or sharp edges, and are placed at a convenient height for the nurse so that she does not have to stoop unnecessarily when washing very small children (see Fig. 147).

In ward units in which fixed baths are not provided in the single-bed wards, there should also be a changing-room. The changing-room (of about 100 sq. ft. in area) should communicate on one side with the sluice-room and on the other with the bathrooms, and should contain a utensil for napkins and a lavatory basin for the nurse's

use. Destructible napkins should be used and after changing a baby they should be immediately placed in a dressing utensil and covered with disinfectant, then transferred to ward bin and incinerated.

Dressings and minor procedures, e.g. aspirations, of a septic character should never be carried out in an open ward where wound contamination is likely to follow. A special room should be set aside for this purpose, to which the children can be taken. The room should be considered as an operating theatre, with all its associated aseptic techniques practised.

There should be a preparation room for infants' feeds, equipped with facilities for washing and sterilising babies' bottles and containing a refrigerator for the preservation of prepared foods. An area of 90 sq. ft. is required for the preparation room, which should be planned as an annexe to the ward kitchen. Provision must be made for a calorifier over the hot-water-bottle sink. Milk forms a most important part of the dietary; it also forms a perfect culture medium, and special care must be taken to ensure cleanliness and protection from contamination.

The sanitary offices should have, in addition to W.Cs. with low seats, a small common room or space for chambers used by tiny children; this space should not be closed in.

The duty-room should be so placed that the nurse is able to observe the children in all the wards without leaving her station and so that foot travel is reduced to a minimum. The treatment room, for obvious reasons, must be placed as far away as practicable from the patients' wards. In order to provide privacy for parents who wish to consult the doctor, a small waiting-room near the entrance to the unit is desirable.

From time to time children may be brought from the out-patients department to the ward unit for examination, but not necessarily for admission. If this is done, there should be a special waiting-room and examination room, if the introduction of infection from outside is to be avoided.

Isolation. In addition to the requirements outlined in the preceding paragraphs, a children's department should always contain isolation accommodation apart from the ward units. The amount of isolation accommodation required depends, to some extent, on the facilities available for transfer to an isolation hospital.

Isolation accommodation should not only include isolation cubicle wards as such, but also a number of single-bed wards; the main wards are also divided by glazed partitions, thus securing a certain measure of partial isolation. See Plate XLIV.

The London County Council have designed an isolation unit comprising a number of single-bed cubicle wards, each 11′ by 10′, divided by glazed screens, a sister's room, and babies' nursery 15′ by 10′, situated on the southernly side of a glazed corridor. The latter opens on the east side to the sanitary annexe, patients' lavatory and bathroom, and on the west side to the staff lavatory, clinical room, linen store, and work kitchen with larder, etc. On the north side of the corridor a treatment room, 11′ by 10′,

blanket-drying room, sterilising-room, and cleaner's room has been planned. The clinical room can be used alternatively for special dressings or other purposes.

The temperature normally required in children's wards is 60 deg. to 65 deg. F. but provision must be made for raising the temperature from 65 deg. to 70 deg. F. when used for cases of measles. Good ventilation is of the first importance in reducing air-borne infection, and introduction of fresh air in amount equal to 8 to 10 changes per hour is required; although this demands expenditure for heating in winter and needs careful attention to the avoidance of draughts.

29
Tuberculosis

THE TREATMENT of tuberculosis has undergone striking development during the last quarter of a century. With the advances that have been made in treatment has come an increasing need for skilled medical supervision and more elaborate equipment, as a result of which the size of the economic unit has increased.

Although special tuberculosis hospitals will normally be provided (see Chapter 33), it is generally accepted that some separate accommodation will be provided as a part of a general hospital. The functions of T. B. wards in a general hospital are quite distinct from those of separate hospitals for the tuberculous, though sometimes the latter do provide a section of the hospital for the same type of tuberculous patient as is admitted in London and other places to T. B. wards of general hospitals.

The T. B. wards in general hospitals are for:

a the symptomatic relief and isolation of advanced patients who are seriously ill;
b the observation of patients for the purpose of establishing diagnosis where this is doubtful and determining the most suitable type of hospital for further treatment.

It is quite impossible to provide a hospital bed for every patient whose sputum contains tubercle bacilli, as the number of beds required would run into tens of thousands.

PLANNING

The planning of a ward unit for tuberculous patients is very similar to that for acute patients. The number of beds which can be controlled effectively by one sister varies with the type of case occupying them. A ward unit occupied by bedfast patients should obviously be smaller than one in which the patients are mainly ambulant, and The Report states the size of the unit can therefore vary within fairly wide limits, say from thirty to fifty beds. The Medical Officer's Departmental Committee of the London County Council consider that as male phthisisal patients are the most difficult to control, the ward unit for such cases should not contain more than twenty-four beds under one sister, or twenty for preference, especially in general hospitals where the type of patient is often advanced. This opinion is in sharp contrast with the view held by other authorities who consider that forty beds of either sex can be controlled by a single sister in a hospital ward unit of a sanatorium. A ward unit of fifty beds under the

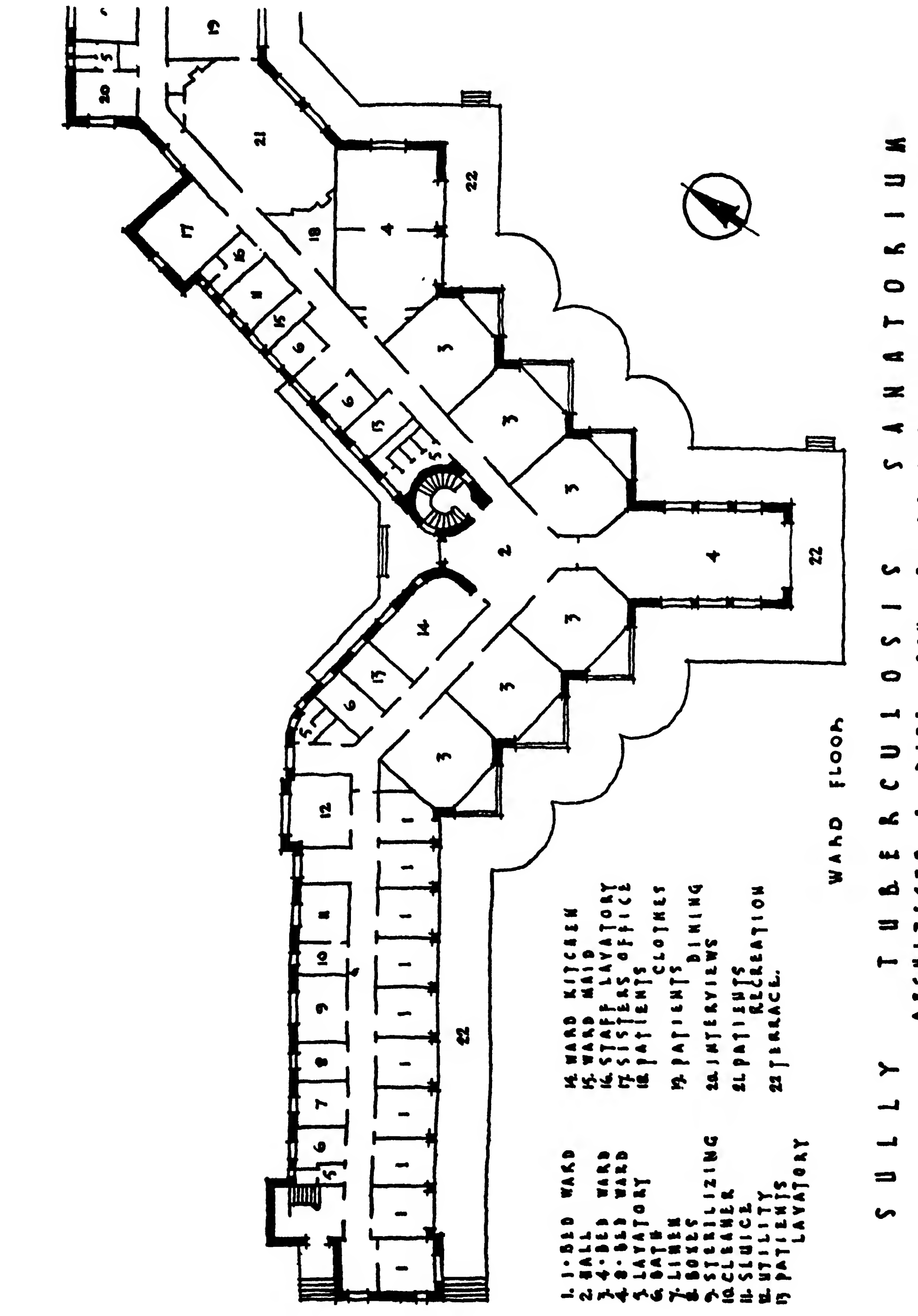

1. 1-BED WARD
2. HALL
3. 4-BED WARD
4. 8-BED WARD
5. LAVATORY
6. BATH
7. LINEN
8. BOXES
9. STERILIZING
10. CLEANER
11. SLUICE
12. UTILITY
13. PATIENTS LAVATORY
14. WARD KITCHEN
15. WARD MAID
16. STAFF LAVATORY
17. SISTERS OFFICE
18. PATIENTS CLOTHES
19. PATIENTS DINING
20. INTERVIEWS
21. PATIENTS RECREATION
22. TERRACE.
WARD FLOOR
SULLY TUBERCULOSIS SANATORIUM
ARCHITECTS : PITE SON & FAIRWEATHER

FIG. 148.

control of one sister would not be unreasonable when only ambulant or less acutely sick cases are accommodated.

ACCOMMODATION

Wards. There is general agreement that large wards are undesirable for the treatment of cases of pulmonary tuberculosis, and small wards with a maximum of four beds are recommended, but with only two beds for preference. The beds should be placed either against an inner partition wall or facing the windows so that patients may have an uninterrupted view into the open and secure effective access of sunshine; therefore the ward blocks should be planned to secure for the patients a certain degree of protection from too free ventilation and exposure to inclement weather.

Variety in the types of ward has been suggested as a means of providing a change of outlook for patients transferred from one ward to another. The types of ward suggested by the London County Council are:

- *a* wards arranged on each side of a central corridor;
- *b* veranda wards, e.g. with folding screen or similar open front veranda;
- *c* four-bed open wards separated by low-glazed screens, with facilities for cross-ventilation. This type is not so popular with patients as the other two types, as cross-ventilation is inclined to be overdone in tuberculosis hospitals.

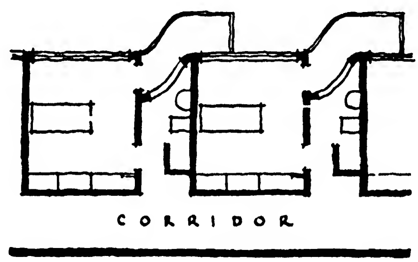


FIG. 149.

The provision of these three varieties of ward has the advantage of providing elasticity and conditions suitable to patients in various stages of disease.

The ideal solution for wards is the single-bed unit composed of bedroom, lavatory, and balcony. This is simple for one-storey buildings, but for two or more, the balcony is the difficulty. The real defect in a continuous balcony—in addition to the shadow the overhanging balcony casts—is the lack of privacy. When the wards are planned with their axis at 45 deg. to the corridor, privacy and insulation from noise are obtained but are brutalised by the jig-saw planning of the interior. Mr. W. T. Brown in an article, "Model Sanatorium," published in the *Architects Journal*, dated April 1935, describes and illustrates the ideal unit plan capable of unlimited repetition. The entrance is set back from the corridor, and the balcony, while being partially protected, does not shade the ward. The windows of the lavatory are above the level of the lintel and therefore not visible in elevation. The patient can sit at the door of the balcony, under cover, facing due south, without being overlooked (see Fig. 149). The end window of the adjoining ward overlooking the balcony is glazed with translucent but non-transparent glass.

The wards can also be in a double-V formation, with a south-eastern aspect and arranged on the sun-trap plan, with the outside walls of the small wards (say four beds), mainly of glass, in the form of large projecting bays. This type of plan was adopted at the Welsh Memorial Tuberculosis Hospital at Sully, nr. Cardiff (see Fig. 148), and appears to combine the maximum advantages of sun and shelter. With stepped-back windows as at Sully, they provide alternative ventilation, shelter, and outlook, according to direction of sun and wind. The ward windows slide wide open on to a terrace at ground-floor level and on to narrow promenade balconies on the upper floor, in the case of the single-bed wards.

There have been various other designs than the V-shaped to single-bed wards adopted in some French sanatoria (see Fig. 150), which give a curious honeycombed effect to the south front of the patients' block. A T. B. ward is not a sun-hospital, and provision must also be made for wards for those certain cases to which sunshine is not only useless but actively harmful. In the treatment of some advanced cases of pulmonary tuberculosis exposure to direct sunshine may be undesirable.

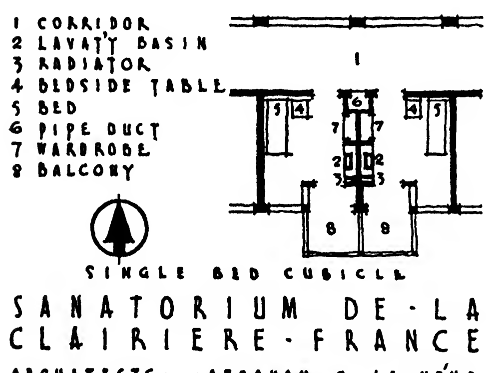


FIG. 150.

The Report on the question of fresh air and sun states that for patients who will spend most of their time in bed, it is desirable to have a terrace or balcony wholly or partly open to the sky, on to which the beds can be wheeled. For ambulant patients accommodation of this type is not required, and their needs can be met by providing wide windows which can be opened to give a high degree of open-air conditions. Wide windows are desirable in most of the patient accommodation; but a number of the single-bed wards may be required for patients who need greater warmth and a more uniform air temperature than the others, and for these wards normal windows would be more suitable.

The open-air conditions which prevail in tuberculosis hospitals affect the question of bed space, and experience has shown that an allowance of bed space somewhat smaller than that required in a general ward is appropriate. The accepted standards of floor space for tuberculosis patients recognised by the Ministry of Health are:

- *a* adults (pulmonary), 64 sq. ft. per patient and 8 ft. between bed centres
- *b* adults (non-pulmonary), 64 sq. ft. per patient and 6 ft. between bed centres
- *c* children (pulmonary), 50 sq. ft. per patient and 6 ft. between bed centres
- *d* children (non-pulmonary), 50 sq. ft. per patient and 5 ft. between bed centres;

whereas The Report recommends that single-bed wards should have an area of 90 sq. ft. and other wards an area of 80 sq. ft. per bed, with a height not exceeding 10 ft.

Day-rooms. These are necessary, their size depending on the proportion of patients likely to be able to make use of them. They should be charmingly appointed where patients might repose, read, listen to the radio, and be away from the ward atmosphere. Everything that can be done to engender cheerfulness and a hopeful attitude should be done, as this is reflected in the demeanour of those who are recovering.

Verandas. Where the direct rays of the sun are required, balcony designs are very frequently used in those wards, for such special cases as orthopaedic and surgical can best be treated in the open-air and sunshine. The provision of verandas and balconies has not been fully solved by the adoption of the transverse layout of the ward unit. When this need is stressed, an expensive solution is sun-decks, provided by stepping back the ends of the buildings in such a manner that each deck is open to the sky and made safe by the provision of permanent metal mesh screens rising to adequate height above normal parapet level. The decks can be inter-communicating by short flights of stairs like the decks of a ship, allowing safe and easy alternative means of escape in case of fire. This stepped end design is very suitable for restricted sites, as in addition to providing sunny relaxing areas adjacent to the wards, it allows a higher percentage of such areas to those floors which are correspondingly farther removed from ground facilities.

With two-storey blocks, the adoption of the double corridor on the ground floor, to provide the necessary bed terrace over, has the advantage of giving quietness to the single rooms. This has been adopted at the Whiteabbey Sanatorium, near Belfast. It might, however, be advisable to consider if lighting bays would not give a more advantageous arrangement as it would provide cross-ventilation and better lighting.

In sanatoria for tuberculous patients (as distinct from T. B. hospital wards) ample means for ventilating the upper portions of the verandas must be provided, otherwise stagnant air may become trapped, with most deleterious results. In this connection it may be noted that glazed balcony roofs inclined upwards to secure the maximum admission of sunlight to the wards from which the balconies open (see Plate XLVI), with a valley gutter next the wall in place of the usual glazed lean-to roof sloping downwards from the ward wall with a gutter along the outer edge, constitute the best prevention of stagnant air (see also Fig. 77).

Ancillary Rooms. In a ward unit occupied mainly by bedfast patients the sanitary accommodation and other ancillary rooms should approximate closely to those of an acute ward (see Chapter 18).

Sanitary provision on a more liberal scale will be necessary in a unit intended mainly for ambulant patients, while in such cases the provision of service rooms may be somewhat reduced. In a ward unit for ambulant cases The Report recommended the following standards:

a W.Cs.—one to eight (with a urinal in male units)
b baths—one to ten
c lavatory basins—one to six.

In addition to sterilising in ward kitchen, provision must be made for sterilising systems for sputum, mugs, and linen, and for a small gas incinerator in the sluice-room.

In selecting sanitary fittings it must be remembered it is desirable for patients to wash themselves in running water. For that reason, the wash-basin has no plug, but only a grating over the waste opening. It is also customary to provide separate dental bowls in order to eliminate sputum from the wash-basins.

30
Isolation

THERE IS A DEMAND from some authorities for the inclusion of isolation facilities in general hospitals. The extent of this need is difficult to gauge. The fact is that the proper isolation of all contagious diseases, except smallpox, is much more a matter of nursing technique than it is of physical facilities other than those provided by a single room with bath and toilet facilities. In the case of minor contagious diseases, such as measles, chicken-pox, diphtheria, and scarlet fever, the demand is more due to an effort to avoid the inconveniences of quarantine at home than to any purely medical necessity. The provision of a specially planned isolation section is not particularly expensive in its initial cost, but its maintenance is so very great that few hospitals can afford it, unless subsidised for the purpose. Practically all diseases for which isolation is needed are of seasonal occurrence and usually in more or less well defined epidemic periods. Also, each one of these diseases must be isolated from the others as well as from other non-contagious cases in the hospital. The duration of the epidemics of any of these diseases is seldom over a few weeks' duration, although a period of increased incidence of one may overlap that of another.

The net result of all these considerations is that any area permanently assigned to the care of isolation cases is likely to be too small when the peak of an epidemic is reached, and when that epidemic has passed is likely to remain vacant and unused until another contagious disease reaches epidemic proportions. Hospitals, like hotels, find that "the most expensive thing in the house is an empty bed." Thus, the isolation unit is subject to such long periods of vacancy and near vacancy, that its cost of maintenance is likely to be three or four times that of an area of similar capacity elsewhere in the hospital.

In a fever hospital all types of infection, except smallpox, are admitted, yet the nurses all live in the same nurses' home and they do not convey infection from one ward to another. In view of this there is no reason to believe that by living in a nurses' home with nurses from other parts of a general hospital, they would be responsible for conveying infection to the non-isolation wards. Accordingly there is no need to provide separate staff accommodation.

A certain proportion of isolation accommodation, however, should be provided in isolation wards in general and children's hospitals for cases of inter-current infection, which could be more advantageously nursed there, e.g. cases where the patient is too ill to be moved or where special continuous treatment is necessary, which could not be obtained in a fever hospital.

PLANNING

From the isolation-room of the receiving unit in the out-patients department of municipal hospitals for suspect cases, patients are taken by a separate corridor, staircase or lift to the isolation ward of the hospital. All other doors leading to this stair are arranged for fire escape only, and the main stairways of the building are screened off on this segregation floor and provided with emergency doors.

As an alternative, the ward block should be situated in an isolated position and not less than 40′ from the boundary of the site. An access road should be provided.

ACCOMMODATION

A block similar to a cubicle block described in Chapter 34 should be provided (see Fig. 151).

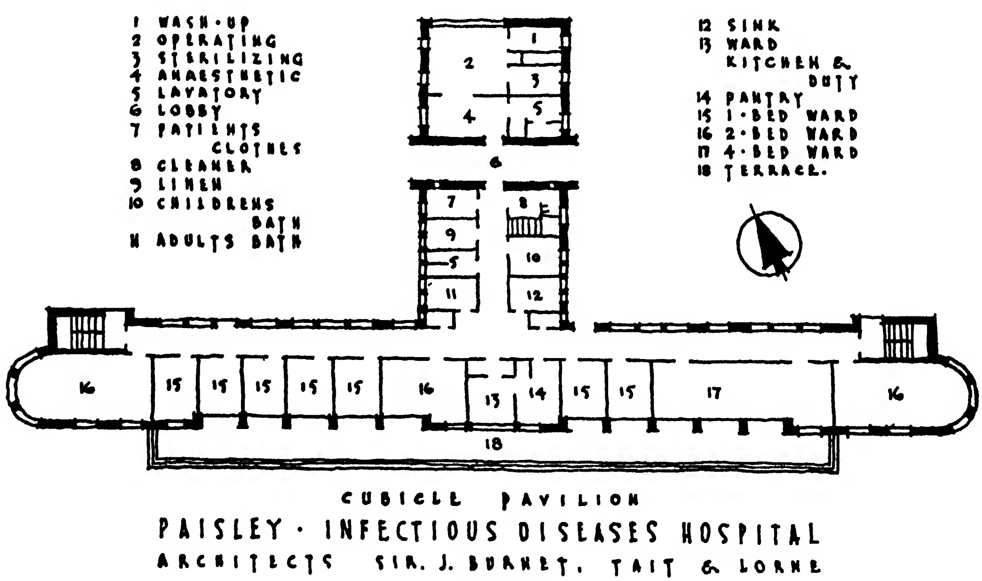


FIG. 151.

31

Psychiatric

DECLARED MENTAL DISEASE is not best treated in connection with a general hospital although at least one of a group of two or three general hospitals should have wards and separate block for the observation of early acute cases of mental diseases, as well as for the treatment of those not requiring certification, because in both there is so often some physical illness that needs attention at the same time. This also has the advantage of readily available psychiatric advice for any patients in the general wards who need it.

The London County Council Maudsley Hospital was the first clinic established for early cases of mental disorder in Great Britain, and mental observation wards for the more seriously deranged have been attached to the infirmaries of the late Board of Guardians for many decades.

Psychiatric wards in the past have been a most unusual provision in a general hospital, but Guy's Hospital, London now has a lecturer in psychological medicine, and a psychiatric clinic (York Clinic) was erected in 1940 (see Fig. 152). This clinic is part of the general teaching hospital, and as the Board of Control put the experience of its own architect at the disposal of the planners, it is symbolic of a determination that social and scientific progress will go forward hand in hand at an increased speed.

York Clinic is intended to fulfil the wants of patients for the treatment both of psychoneuroses severe enough to require in-patient treatment and of psychoses. The purposes of having it within the precincts of a general hospital are:

a first, to encourage the early treatment of all such conditions as can be admitted with no other formality than attends the admission of any other type of case to a general hospital;

b secondly, in the future to facilitate and intensify the teaching of psychological medicine in all its aspects both as a social and medical science.

This clinic contains forty-two beds and is on five floors, the ground floor being devoted to public rooms and offices, the basement to a laboratory, gymnasium, dining-room, etc., and the roof to recreation space. The clinic has been planned, within the limits available, as a place where the patients can live without being confined to bed. For this reason there is the maximum amount of day space that it was possible to provide. The corridors are especially wide and can be used as lounges, and

besides the public rooms already mentioned there are occupation rooms on each floor. The majority of the accommodation is in single rooms, but there are some three-bed wards.

For teaching purposes the clinic will work in close association with the out-patient department and with the existing psychiatric beds.

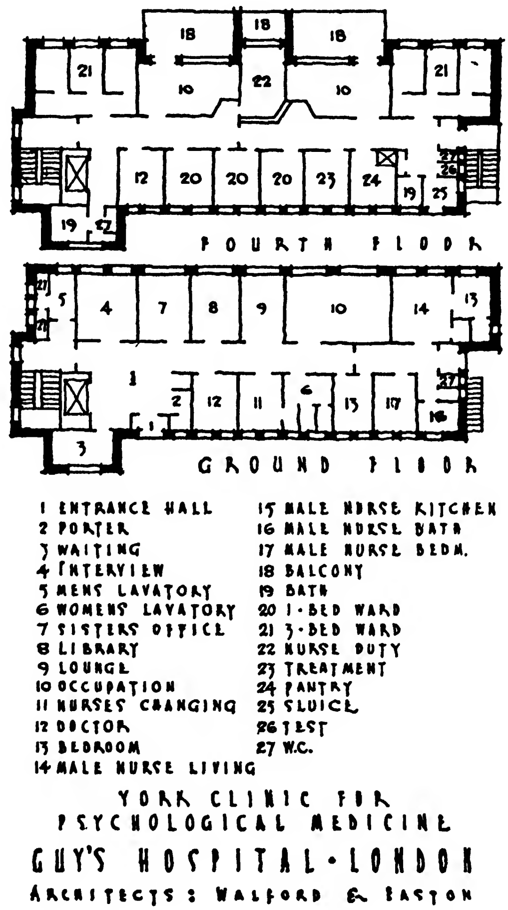


FIG. 152.

SECTION VI

Special Hospitals—Provision of special accommodation forming a separate hospital with its own administration

32
Chronic Hospitals

A GOOD MANY CASES of chronic illness, after thorough investigation in a general hospital, can be usefully transferred to longer-stay hospitals. Institutions for younger patients such as those with chronic heart trouble or requiring rehabilitation treatment are best situated in the country, but old people, who are not likely to recover, will be much happier in hospitals near their homes.

The treatment of exclusively chronic diseases has much in common with the treatment of tuberculosis, since in each case patients are hospitalised for long periods and in the majority of cases not entirely bedridden.

Chapter 26 describes the type of patient and ward unit required when wards are provided in a general hospital. When the number of patients of this class is large it may be more convenient to provide for them in special hospitals.

The condition of the patients and the fact that active treatment is not in progress have led to many differences in design in comparison with an acute general hospital. Administration is less complex, different standards of accommodation are appropriate, simpler equipment suffices, and the general activity in the wards and throughout the hospital is different.

The great majority of inmates of the chronic wards are aged or at least well advanced in years, many are enfeebled in mind as well as in body, and a considerable proportion have lost control of their body functions. It is essential that the younger and mentally more alert patients should be separated from the large senile group and should be provided with such occupations and recreation as their condition permits, and it is also desirable to separate from the other patients those who are incontinent or for other reasons physically offensive.

Broadly, the chronic sick are those in need of continuous medical and nursing care and should be in hospitals. The infirm should be in special homes under the direction of a Social Welfare Department.

PLANNING

The considerations mentioned in Chapters 3 and 4 relating to site and general lay-out apply. Low buildings are preferred for making it easier to get patients out into the grounds, on foot or in wheeled chairs.

As many of the patients are not in real ill health but are merely infirm, and have no

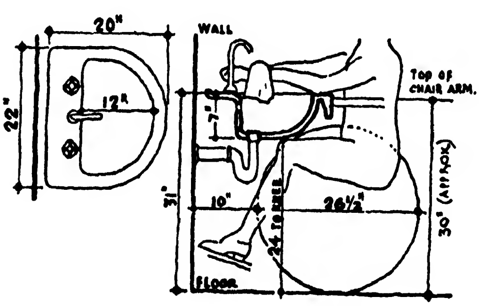
one to look after them continually, they can have a room or two with their possessions around them, in a community where they will have companionship or relative privacy as they wish, and assistance to make their last years comfortable.

The ideal would be to treat chronics in the suburbs, but as relatives prefer to be as near the patients as possible so as to facilitate visiting, a compromise with the ideal is often necessary.

ACCOMMODATION

Administration. A chronic hospital is a much less busy Institution than an acute hospital; the turn-over of patients is very much less; the proportion of staff to patients is lower; and the work of the dispensary is simpler in character and less in amount. Chapter 33 will serve as a general guide when a separate hospital is required.

Residential Accommodation. The accommodation is similar to that described in Chapter 11, with the proviso that the staff is smaller and it is common for a larger proportion to be non-resident.



BASIN FOR CHRONIC PATIENTS

FIG. 153.

Wards. The policy with regard to size and design has been described in Chapter 26.

In selecting sanitary fittings, it must be remembered that many patients will be in wheel-chairs. The lavatory basin must be fixed to enable them to wash themselves while sitting in the chair. Fig. 153 shows the fixing of the basin, which must be fitted a considerable distance from the wall in order that the patients can get close to the basins and get their knees under it. The basin must be curved at the front.

Special Departments. Patients are usually admitted direct to the wards, and a reception department is therefore not generally necessary. A small mortuary is required, to be designed in the manner described in Chapter 14, except that the extent of the accommodation required for bodies can be less in amount.

An operating and a radio-diagnostic department are not required. If X-ray investigation is necessary a portable apparatus will suffice, and for this reason and also for the purpose of electrical treatment one or two electrical power points should be provided in each ward. Massage, electrical, and thermal treatment are commonly applied in the wards, but as there is a considerable field for palliative treatment by physiotherapy, measures envisaged in post-war planning, a special department may be necessary.

33

Tuberculosis Hospitals

CHAPTER TWENTY-NINE describes the type of patient and ward unit required when wards are provided in a general hospital.

In consumptive diseases such as those described, therapeutic efficiency combined with complete isolation from the community have led to the provision of sanatoria. Sanatoria as such are primarily for treatment, not for isolation, although as previously mentioned certain mixed institutions for the tuberculous which may be called sanatoria have wards for advanced cases. Two of the finest were the immense Benito Mussolini Sanatorium in the Apennines and the Mazaryk Sanatorium just outside Prague. Situated on a wide open plateau shut off by a screen of woods from the nearest suburbs, the latter's plan consists of isolated groups of blocks co-ordinately arranged.

Figs. 154 to 156 illustrate possibly the finest tuberculosis sanatorium in the world, at Paimio in Finland. The South-West Finland Tuberculosis Sanatorium, as it is named, on account of its isolated position, is a self-contained community designed on a central axis with radiating wings. The main wing contains two-bed wards and lying-in halls; another wing contains administration, operating theatres, and dining-halls, etc. Service wings contain laundry, kitchen, power house, etc.

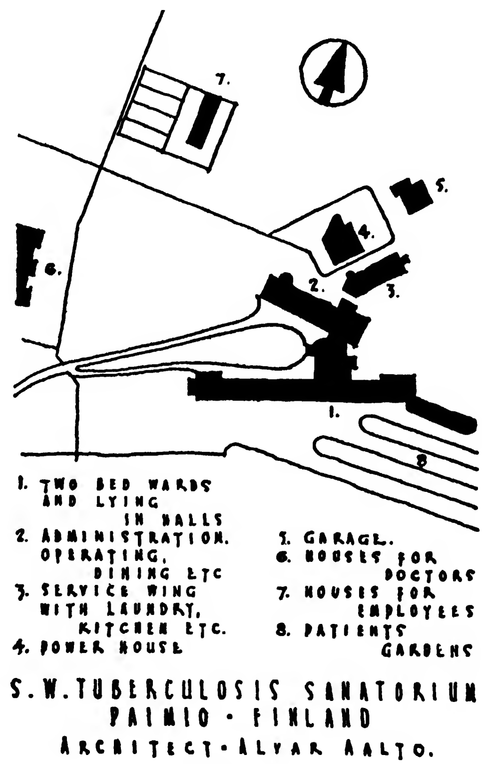


FIG. 154.

Fig. 157 illustrates a tuberculosis ward in Switzerland and Fig. 158 a large sanatorium erected by the Middlesex County Council. This block plan indicates the placing of the patients' wards relative to the central administration and service departments, with which they could be connected by covered ways, and also shows the location of the staff home, school, general recreation room, power-house, laundry, etc.

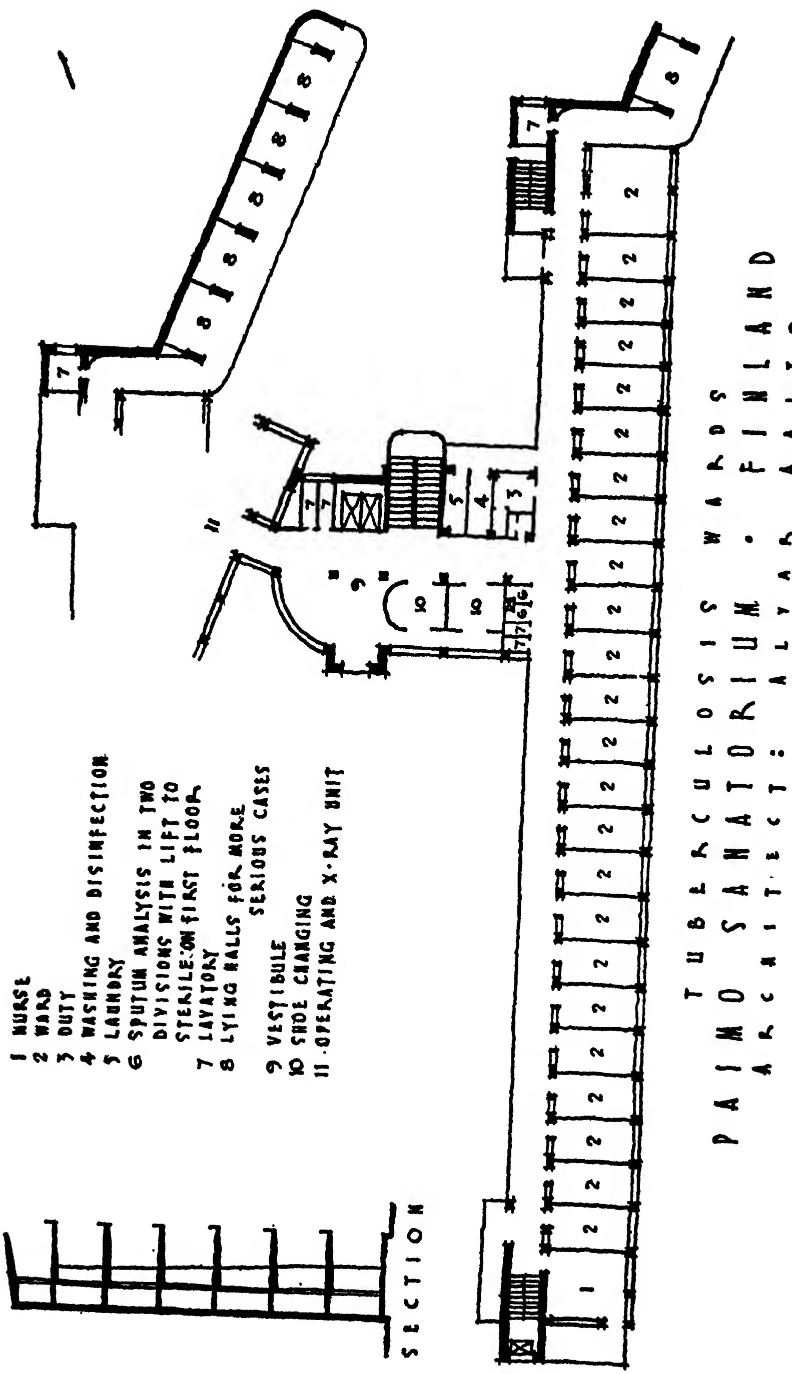

1 NURSE
2 WARD
3 DUTY
4 WASHING AND DISINFECTION
5 LAUNDRY
6 SPUTUM ANALYSIS IN TWO DIVISIONS WITH LIFT TO STERILE: ON FIRST FLOOR
7 LAVATORY
8 LYING HALLS FOR MORE SERIOUS CASES
9 VESTIBULE
10 SHOE CHANGING
11 OPERATING AND X-RAY UNIT
SECTION
TUBERCULOSIS WARDS
PAIMIO SANATORIUM . FINLAND
ARCHITECT: ALVAR AALTO

Fig. 155.

Treatment is more prolonged and less Spartan than formerly. As patients are under no compulsion to stay, they must be induced to do so by providing reasonable comfort. Such amenities as well-planned and well-kept grounds, pleasant recreation rooms, and wireless receiving equipment for the patients are not luxuries, but essential factors in treatment.

Opinion is divided, however, on the question of the advisability of providing some degree of heat in sanatoria. The Ministry of Health has approved the installation of some form of heating during the inclement periods of the year in certain parts of exposed and bleak sanatoria in the North of England. Furthermore, the argument is adduced that ambulant patients do not need coddling and that patients in bed can be kept warm with hot-water bottles and blankets. It may be considered necessary to provide heating for a certain portion of the day only instead of continuously, and it would therefore be advisable and economical to arrange for some form of control of heating. The subject of heating in sanatoria is further dealt with in Chapter 37.

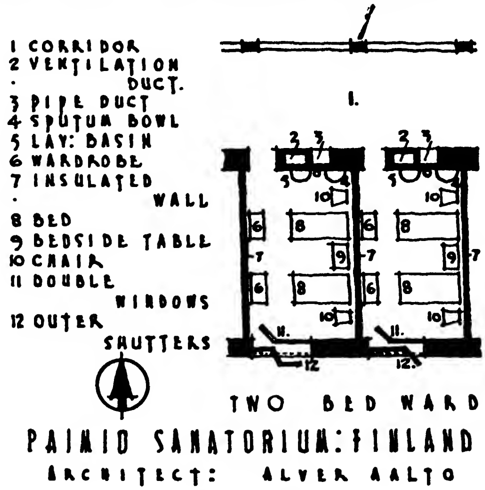


FIG. 156.

Rest plays a larger and exercise a smaller part in treatment than formerly. This and

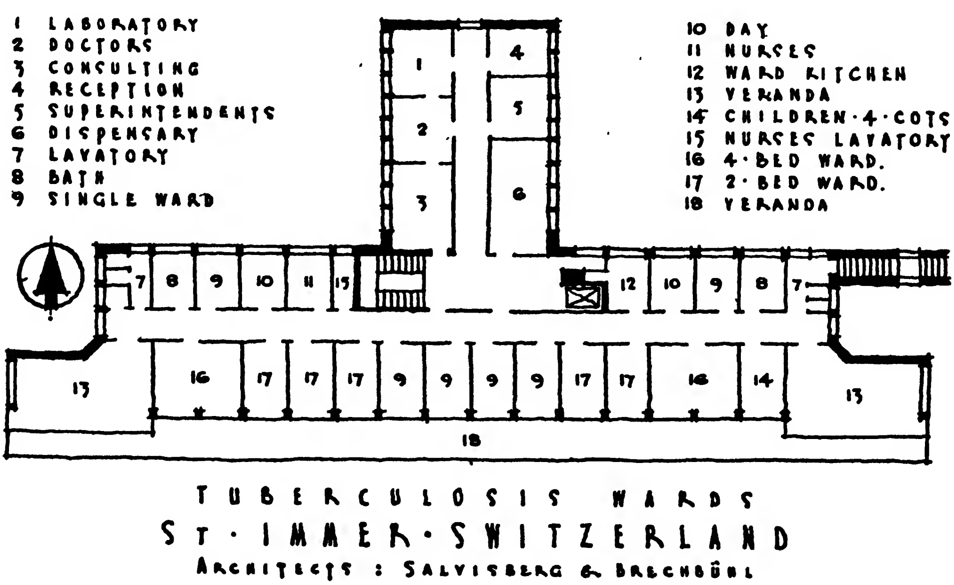


FIG. 157.

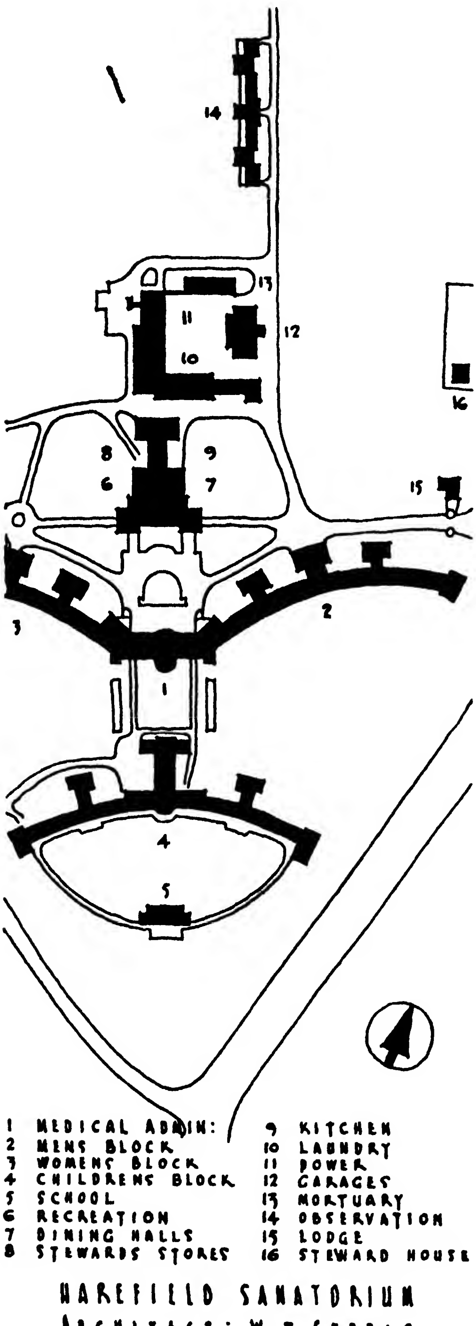


FIG. 158.

the increasing tendency to treat both early and moderately advanced cases in the same hospital result in a smaller proportion of ambulant cases and a larger proportion of bed cases. The hospital section of a sanatorium in the future could with advantage be enlarged accordingly.

Graduated labour has receded and occupational therapy by light handicrafts has advanced in importance, and proper workshops should be provided for use by patients rather as part of their treatment than as training for subsequently earning a livelihood. No unduly elaborate machinery is necessary. Large workshops divided, say, by screens or furniture for group working and class teaching are all that are necessary. Separate workshops for male and female patients should be provided.

There is a movement to make sanatoria the centres for industrial settlements for tuberculous persons with their families. This demands land for cottages and hostels and workshops in close proximity to, but distant from, the sanatorium buildings.

Finally, it was stated many years ago by the late Sir Pendrill Varrier-Jones, in his pioneer work for the tuberculous, that it is the whole person who must be treated, and any attempt at restoration to health and activity which overlooks the patient's home and family circumstances is foredoomed to failure.

PLANNING

The considerations mentioned in Chapters 3 and 4 relating to site and general lay-out apply.

The area of the site selected should be sufficient to provide ample space for recreation and exercise, with an appropriate degree

of separation of the sexes if both are admitted. Although the site should preferably be in the country, it is important that the sanatorium should be reasonably accessible, and in selecting the site attention should be paid to transport facilities to ensure that patients may not be unduly cut off from their relatives and that the staff may have ready access to a fair-sized centre of population.

The usual practice, until immediately before the war, has been to adopt single-storey pavilions, but then there was an apparent tendency towards greater concentration of buildings of two or more storeys—witness Sully Tuberculosis Hospital, Cardiff (see Figs. 148 and 159). Such an arrangement has advantages, but the type of layout to be adopted should be determined by local conditions and requirements.

In planning, it must be remembered that more than an excellent sanatorium is

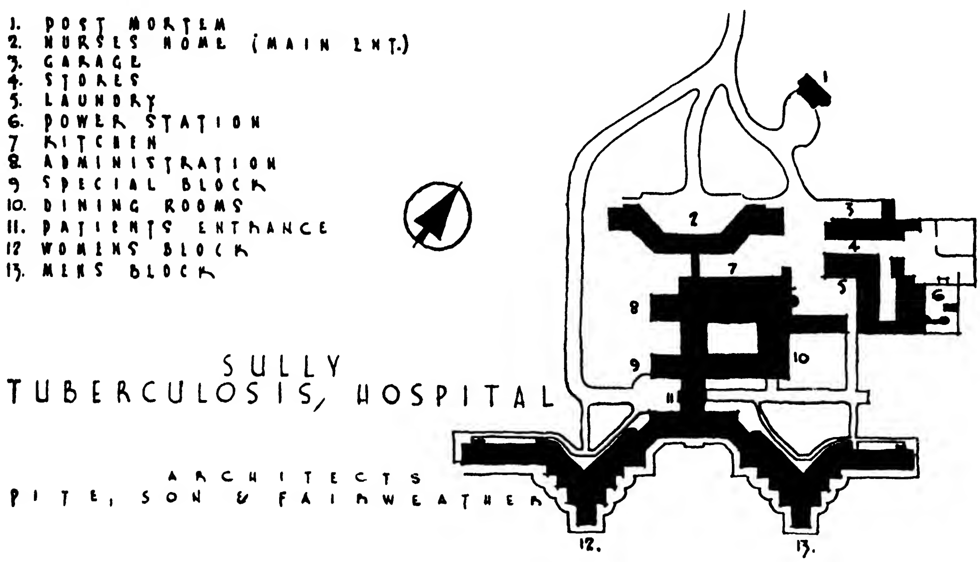


FIG. 159.

required; provision must be made for additional shelter required in a T. B. hospital; also a portion of the site should be reserved for a surgical hospital, a village settlement for convalescents, and a summer camp. It is better to provide for surgical T. B. (that is, tuberculosis of the bones, joints and glands) in an orthopaedic hospital rather than in sanatoria for chest cases, though there should be accommodation for those with both pulmonary and non-pulmonary tuberculosis.

The layout must meet the requirements of three different categories:

a patients
b work of medical staff
c household services.

The patients' wards are considered first, and the layout is determined by the orientation and access; staff and services to the north and the wards to the south. Patients

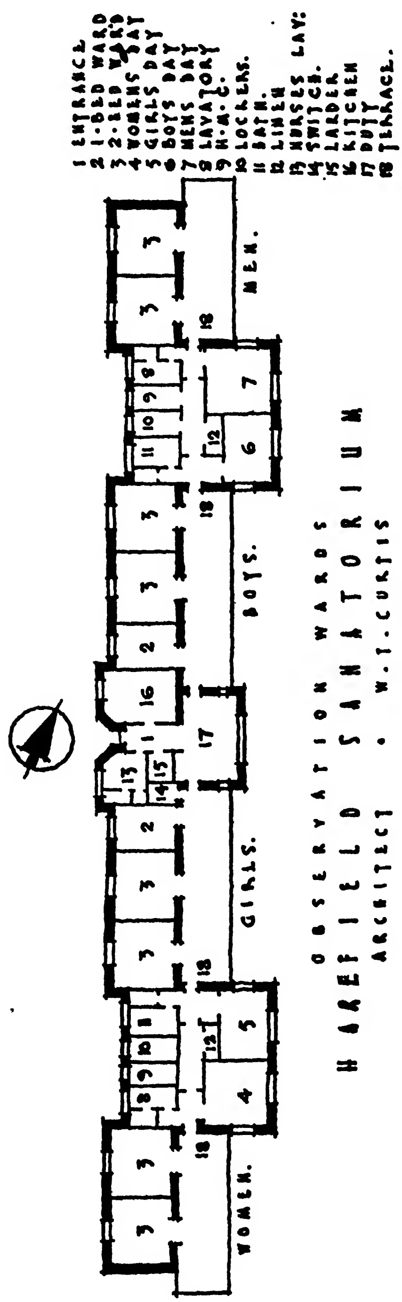


Fig. 160.

suffering from pulmonary tuberculosis should be kept apart from the wards of the other patients.

The ideal layout should allow adequate isolation and at the same time give the maximum protection from the winds coming from the north and east. Those communal services which require sunlight should not be shaded by the rest of the building, and should have a view across to the south. Every advantage must be taken of the possibilities of the site in the layout of the grounds for ambulant patients, for out-door recreation, and for exercising in sheltered situations.

There are two schools of thought on the main principle of layout. They are:

a it should provide a free traffic system, with traffic-ways at a distance from the wards, so that the wards are in parkland, with minor traffic approaches to connect them with the main roads; connecting service ducts are required between all the units;

b it must be compact, and the normal covered ways eliminated by the provision of a central corridor from north to south, bifurcating to east and west, giving access to the various blocks.

The principal entrance, administrative department, residential homes, laundry, powerhouse, workshops, medical superintendent's house, etc., all require careful siting in relation to the special units. The special departments block, containing the operating theatre, radiodiagnostic rooms, etc., should be placed behind the ward blocks, the kitchen and dining-halls behind the special departments. The laundry, stores, power-house, and isolated post-mortem block should be placed some distance away from the wards. The provision of covered ways, with a central partition but with open sides, connecting the ward blocks and administration is desirable.

At the Harefield Sanatorium (Middlesex) the open type layout has been adopted, with wards giving the greatest possible exposure to sunlight. Privacy is obtained by means of small ward units for from one to four patients. The ward blocks—a separate one for men and women—are three-storey buildings with wide verandas facing south, and a continuous corridor on the north of the wards giving access to annexes containing

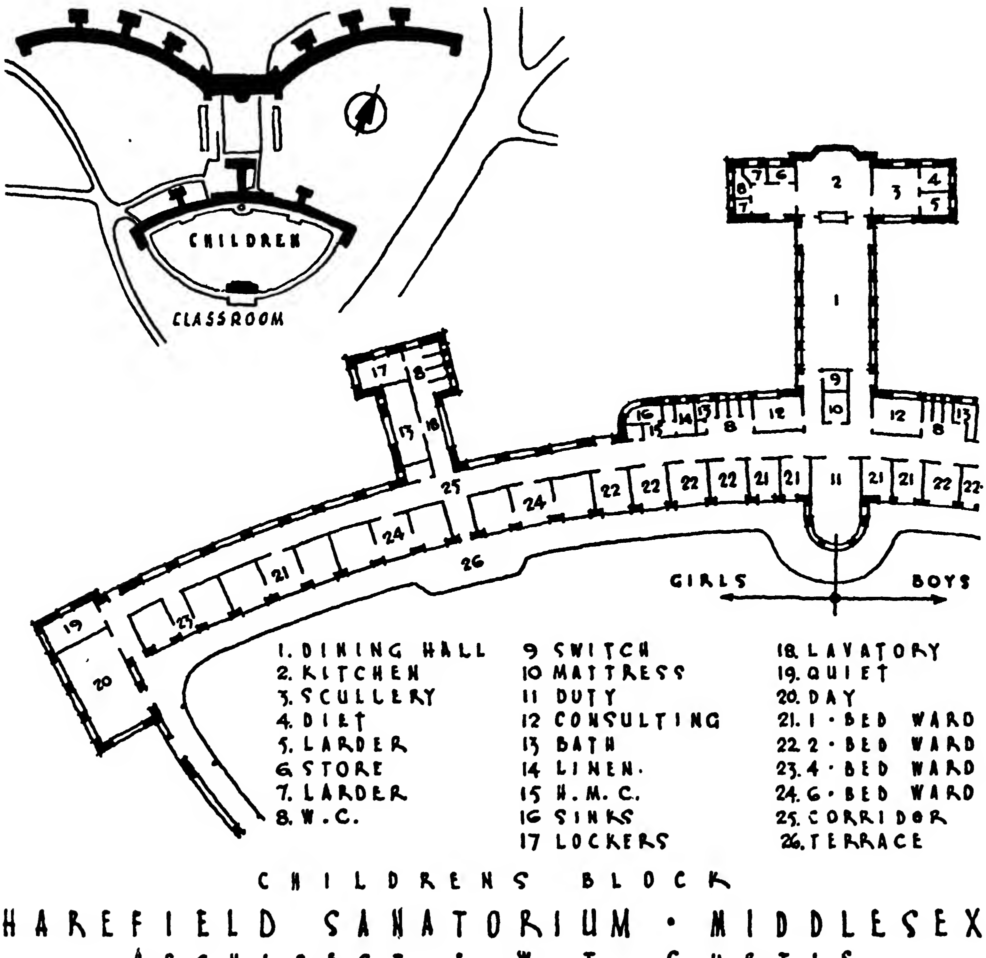


FIG. 161.

the ancillary unit (lavatory, locker-room, baths, etc.), while the other is the ward administration unit (casualty room, ward kitchen, linen, etc., and main stairway). At the end of each block—approached by corridor or veranda—is a recreation-room and the alternative fire-escape. The children's department is only one storey high and is self-contained, with its own kitchen and dining-hall; planning is similar to the adults' department. The observation department is of one storey, containing eight double-bed

wards and two single-bed wards, and is provided with separate day-rooms for men and women, boys and girls; each group of patients is divided by either the administration unit (duty-room, kitchen, and nursery lavatory) or the ancillary unit (bath, lockers, sluice, etc.); and a wide terrace is provided in front of each block (see Figs. 161 and 162).

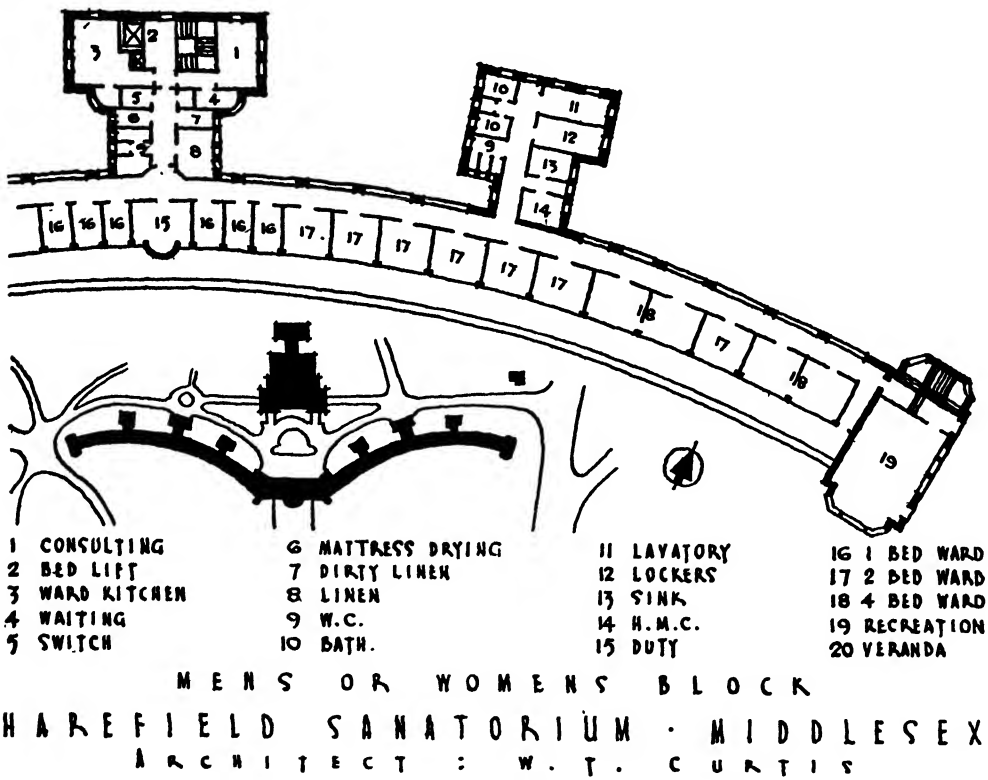


FIG. 162.

ACCOMMODATION

Administration. Owing to the fact that there are usually a considerable number of ambulant patients, a central dining-hall is commonly provided, and this can be used for other purposes, such as entertainments. It should be situated near the central kitchen, and, as it is desirable that the allowance of space for tuberculous patients should be liberal, the Report states that provision should be made on the basis of 14 sq. ft. per patient for the maximum number estimated to be able to use the dining-hall.

In addition to normal dish-washing machinery in the kitchen, provision must be made for sterilisation of cookery, cutlery, and hygienic collection.

Residential Accommodation. The accommodation is similar to that described in Chapter 11. It will, however, be impracticable to use any of the patient accommodation for sick staff, and a small sick bay for the nursing and domestic staff will need to be provided. In the case of a multiple-storey building, this may be situated on an upper floor adjacent to but entirely separate from the patient accommodation.

Wards. The policy with regard to size and design has been described in Chapter 29.

Special Departments. Surgical methods of treating pulmonary tuberculosis are steadily growing in favour, and cases which would otherwise have been given up as hopeless are now amenable to treatment. No sanatorium can now be regarded as fully equipped if it does not contain an operating theatre. See Chapter 24 for details of theatre units. For certain chest operations, the temperature must be capable of being raised to as high as 90 deg. F.

Every sanatorium requires a good radio-diagnostic department. There has been a very great development in the use and efficiency of X-rays for chest diseases. Accommodation for X-ray apparatus should be adequate and the radio-diagnostic room should include direct window lighting and ventilation. See Chapter 21 for further details.

The value of artificial sunlight in the treatment of pulmonary tuberculosis is still a matter of dispute. The general opinion is that light treatment activates pulmonary tuberculosis, but is beneficial to non-pulmonary patients. Accommodation and apparatus (mercury vapour and carbon-arc lamps are suggested) should be provided in sanatoria for non-pulmonary patients.

34

Isolation Hospitals

THE CHIEF MEDICAL OFFICER to the Ministry of Health in a memorandum on "The Control of Cross Infection in Hospitals" stated: "Given good ventilation and bed spacing, the control of cross ventilation turns largely on three things: adequate isolation accommodation, adequate sterilisation and disinfection equipment, and sufficient trained staff to maintain a meticulously careful technique." This is the nucleus of isolation hospital design.

Varying degrees of separation or isolation are required for the different classes of patients and various means are adopted to secure such separation:

a A "barrier" ward. This is an ordinary ward, where, by means of some distinctive mark such as a post or special screen, the medical and nursing staffs are reminded that the patient in that bed must be nursed separately from those in the other beds. This means that each patient must have separate equipment which is used solely by and for him. It should be mentioned, however, that the barrier system is tending to lose favour and its place is being taken by "bed isolation," where each patient is nursed separately, has his own utensils, crockery, etc.; the nurse has a separate overall for each patient and washes her hands after attending to each patient. This has been a development from the barrier system (see Plate XLII).

b "Isolation" or "separation" wards. The difference between an isolation and separation ward, as generally held, is that a separation ward is a small ward attached to a ward in a general hospital, whereas an isolation ward is part of an isolation unit comprising a number of such wards which are generally single-bedded, but which may contain a few wards with two or even three beds each.

c "Cubicle" ward. This is one containing separate compartments, each for one bed only, where the walls need not give complete aerial separation from the adjoining ward or room, as the partitions or screens need only be 7′ high.

PLANNING

The provision of purely convalescent hospitals for infectious cases is not favoured, as it is well known that in times of epidemics of infectious disease, the whole of the available hospital accommodation is required for acute cases. By a specially devised arrangement of the window spacing in the planning of a ward block, however, the ward could

PLATE XLVII. Barrier Ward
Isolation Hospital, Tolworth

PLATE XLVIII. Single Ward
Isolation Hospital, Tolworth

[*To face page* 282

PLATE XLIX. Pavilion Block
South Middlesex Hospital

PLATE L. Corridor
Isolation Hospital, Tolworth

To face page 283]

be used either for acute infectious sick with 12′ bed spacing or for convalescent infectious cases with 8′ bed spacing, as required. Day-rooms, which are needed when the hospital is used for convalescent patients should be so designed that in times of pressure they can be used as wards for the acute sick.

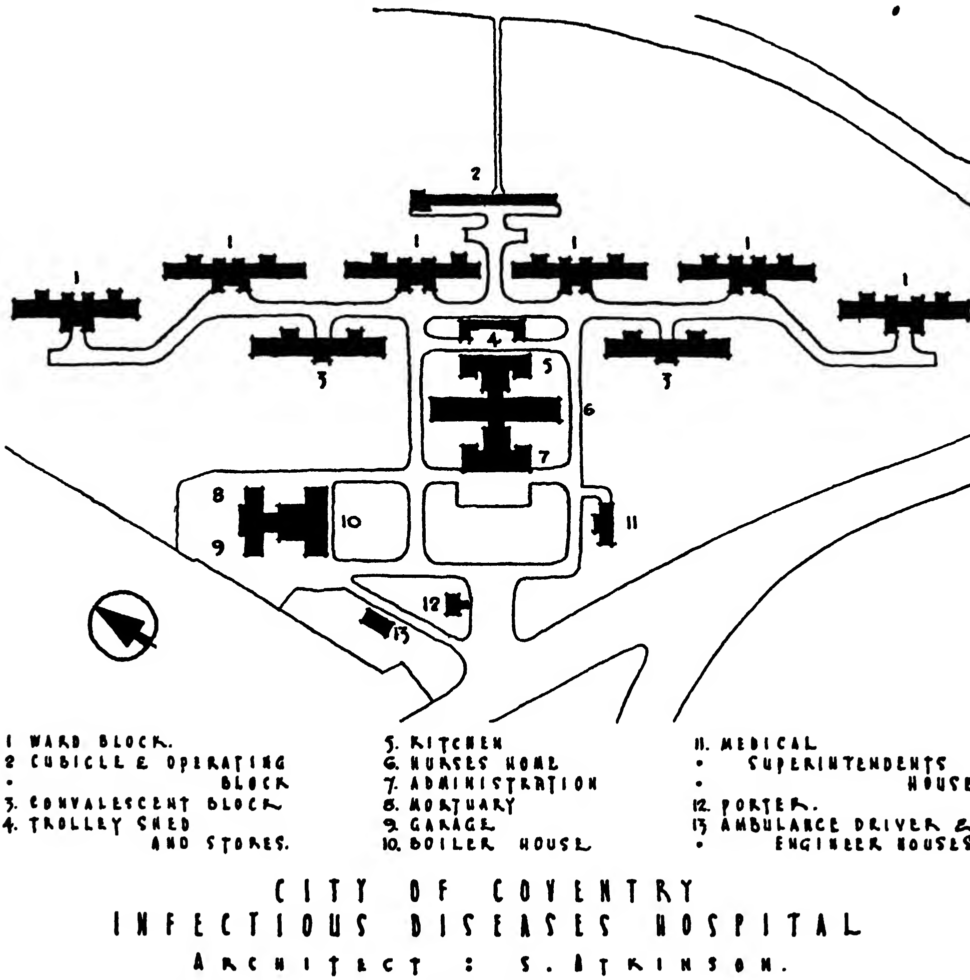


FIG. 163.

The multiplication of diseases treated in isolation hospitals at the present time has led to the demand for far more single-bed wards than was usual in the past, for the segregation of the less common infectious diseases. It is now generally accepted that at least one-third of the total number of beds should be accommodated in one- or two-bed wards, the former being in the majority. This demand is met in two ways:

a small side wards attached to and worked with the large wards;

b special blocks containing groups of single-bed wards, spoken of generally as "cubicle" blocks.

The London County Council North-Eastern Hospital illustrates the first method, with a group of side wards containing eleven beds in three two-bed and five single wards. These are used by patients suffering from the same disease as those in the large ward, but whom it is desirable, for various reasons, to separate. Cubicle blocks are usually one storey containing up to twelve beds in two groups of six, separated by a duty-room. More than six on either side should not be planned, as beyond this number it is difficult to see clearly through the glazed partitions owing to refraction of light.

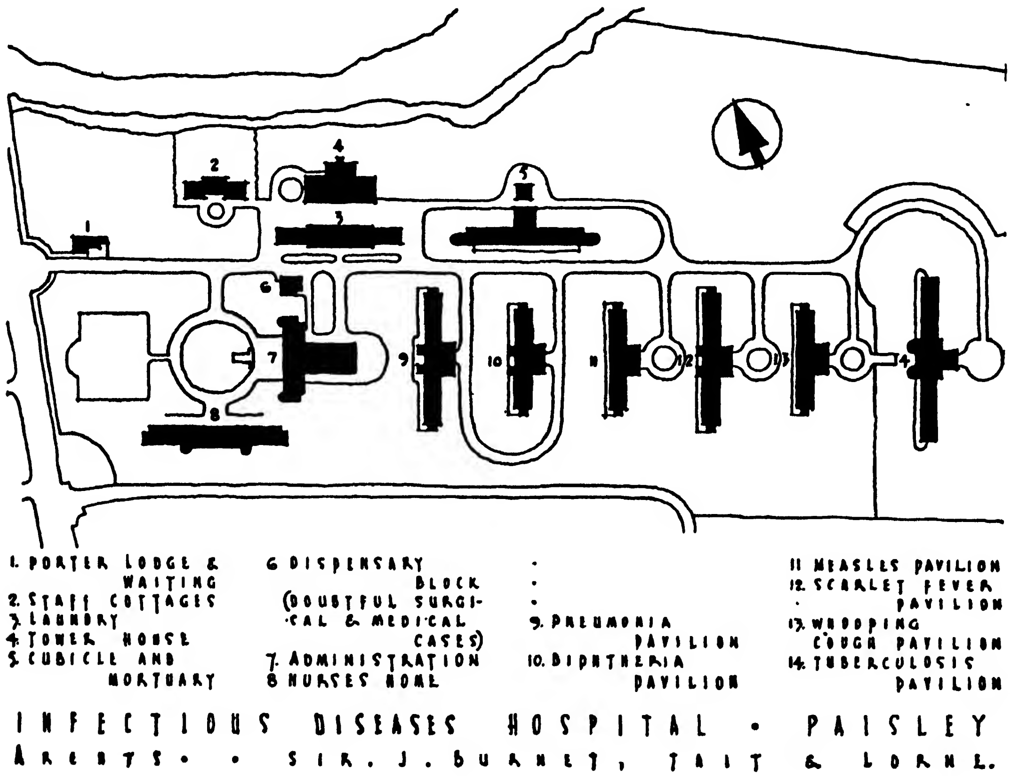


FIG. 164.

Isolation hospitals vary greatly in size, ranging from over five hundred beds in London and some of the large provincial towns to hospitals of twenty-five beds or less in rural areas. It is obvious that hospitals varying so widely in size must differ greatly in character and requirements. To provide a small hospital with the full equipment and facilities appropriate to a large one would be unduly costly, and therefore joint action or co-operation on the part of local authorities is desirable; and in this connection action under Section 63 of the Local Government Act, 1929, should be borne in mind.

Undoubtedly the first thing to do in planning a hospital of this description is to obtain a good layout. The placing of the administration department, nurses' home, and central kitchen in relation to each other and the ward blocks is usually the key to the

problem. The disposition of the ward blocks is of paramount importance. Normally of one storey, the shape of these is very much determined by the levels of the site; for example, with a rapid fall, they should be long, thin blocks with their length running along the contours. Access for ambulances to all ward blocks usually presents no small difficulty. Single wards can be approached from a loggia or covered way, but covered ways between the various blocks are not normally required.

Except for the so-called cubicle block, a ward block should be used for only one disease at a time, and consequently elasticity of accommodation is increased by having numerous small blocks rather than a few large ones.

Any block containing patients or infected articles should be situated not less than 40′ from the boundary of the site, and any block containing patients should be not less than 40′ from any other block.

Normal administrative buildings required include the administration department,

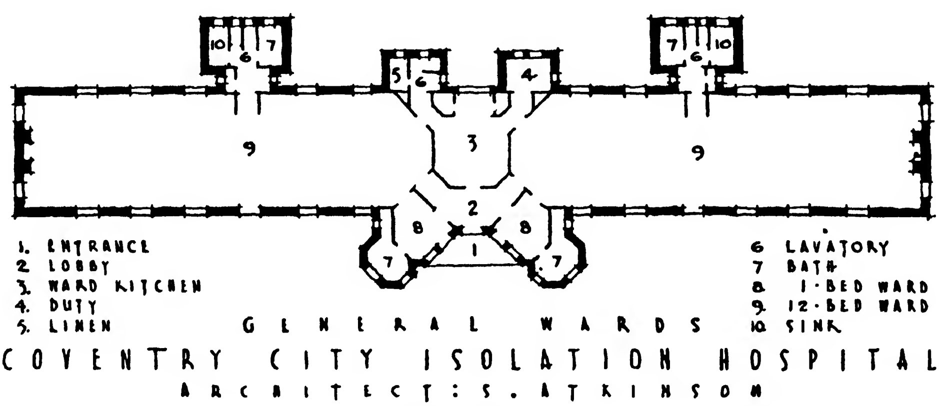


FIG. 165.

staff homes, medical officers' quarters, boiler-house, laundry, disinfector, and destructor, mortuary, ambulance garage, etc. While they are of interest and have their particular problems in every scheme, general details will be found in previous chapters. Whether the different units of the administration department should be situated in one building or not is a matter of opinion. There can be no doubt, however, that a compact arrangement in one building is better, provided that the various units are well segregated. The group should be centrally planned with regard to the wards, central kitchen, and nursing services, and should be accessible to the laundry.

A first-class example is the Infectious Diseases Hospital at Paisley (see Plates XLV and XLVI). Architecturally the building is severe and plain and strictly practical, but there is an elegance of proportion, and such lightness and brightness—white, blue, green, and brillant blue are the outside colours. Inside it is full of colour, not gaudy or strong colours, but the delicate, sensitive colours that a sick person would profit from—pale pinks, blues, creams, aluminiums, and the only decoration is flowers. The hospital is planned with accommodation for one hundred and eighty-one patients, and these

are accommodated in isolated units with a cubicle block for doubtful diseases and surgical cases and six ward pavilions. Other separate blocks are provided for scarlet fever and tuberculosis.

ACCOMMODATION

Administration. An Isolation Hospital is a much less busy institution than an acute hospital. There should not be more than one entrance to the hospital site, and it is usual to provide a porter's lodge alongside the entrance to control admissions.

The porter's lodge is particularly mentioned as provision must be made near it for a public waiting-room and a small consultation room; additional waiting cover, away from the prevailing winds, can be provided by means of a veranda. The public waiting and consultation-rooms are preferably separated from the porter's lodge. There are few visitors to a fever hospital.

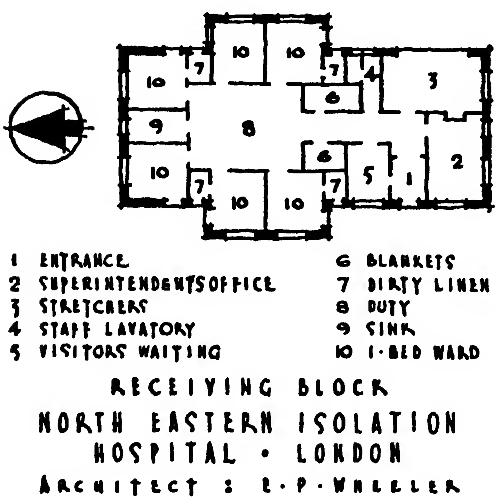


Fig. 166.

Residential Accommodation. The accommodation is similar to that described in Chapter 11, but in a small isolation hospital the administration department and the residential accommodation may with advantage be combined in one building; but in no circumstances should sleeping accommodation for staff be provided in a ward block.

Admission Department. Whether or not an admission department has a positive or negative value is a disputed medical point.

A block has been provided in the London County Council North-Eastern Hospital (see Fig. 166), an interesting plan, whereby six separate wards are provided into each of which a patient can be admitted, examined, and dispatched to an appropriate ward block without coming into contact with the patients undergoing a similar examination.

General Wards. Opinion is not unanimous on the question of the size of a ward unit. A unit can reasonably be planned to accommodate a maximum of thirty beds if there is a proportion of complete isolation accommodation provided—say, up to one-third of the total accommodation—and if due precautions are taken to prevent the spread of infection. The difference of opinion is due to some maintaining that nurses carry infection from one isolation ward to another, and that by limiting the number of beds in the unit the number of patients in contact with each nurse would be lessened, and that if a whole ward were involved in a secondary infection, less mischief would result

in a ward of twelve than one of twenty. If a fever hospital is properly run the nurses do not carry infection from one block to another.

In the typical isolation hospital consisting of small one-storey pavilions each ward block contains only one ward unit. The ward unit may, and commonly does, include beds for both sexes, and it is often found convenient to have it composed of unequal portions, the larger being used for young children of both sexes and older female patients.

The tendency towards small wards is even more marked than in the case of the general hospital, and about twelve beds in a ward should be the maximum. There is much to be said in favour of quite small wards (say of four beds) and each ward unit should contain two single-bed wards.

In the past wards have always been long, rectangular rooms with beds at right angles to the walls and placed between the windows on either side. It is anticipated that the new consensus of opinion will be wards with beds parallel to the walls and glazed

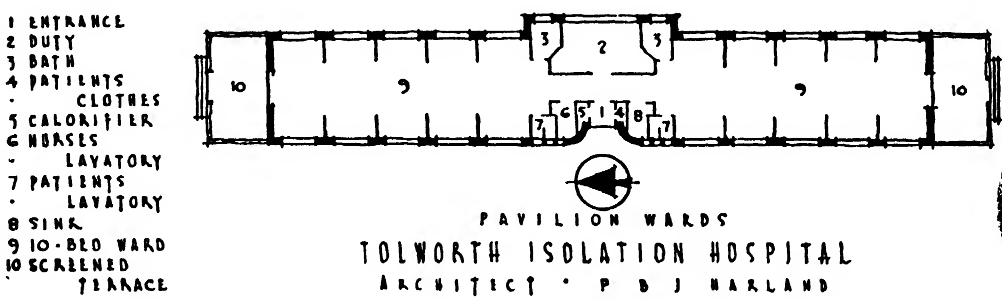


FIG. 167.

screens—previously referred to as the longitudinal layout. There is much to be said for this from the point of view of both nursing and comfort of the patients; this subject has been fully reviewed in Chapter 18. Whereas in acute wards the glazed screens need only be some 7′ high, in all isolation wards they should be continued to the ceiling, both the dado below and the frieze above the glazed observation area being of solid material.

The Ministry of Health recommend for bed spacing, in the normal open ward, a space of 12′ between heads of beds for acute infectious cases, and this involves, with the transverse arrangement of beds and 24′ width of ward, a floor space of 144 sq. ft. The London County Council, however, consider that if the 12′ distance between heads of beds is maintained, the superficial area may be considered of secondary importance, and the floor area per bed can be appreciably reduced, particularly in the longitudinal type of ward in which the beds are placed parallel to the long walls. In a ward of four beds a suitable size is 20′ by 20′, and the 12′ between bed centres can still be maintained. For single-bed wards a room 11′ by 10′ should be provided. There is no objection to the provision of a proportion of the two-bed wards for the accommodation of patients suffering from a similar infection.

Figs. 163 and 164 are layout plans of recent infectious diseases hospitals, Figs. 165

and 167 to 172 of blocks and wards, and Fig. 173 is a typical layout for general wards.

The height of wards containing up to six beds should be 10′, and that of larger wards 11′. The general temperature of wards should be 60 deg. to 65 deg. F., but when they are used for measles the temperature must be boosted to 65 deg. to 70 deg. F.

Some hospitals have special blocks for scarlet fever (see Fig. 168) and diphtheria; and whilst the incidence of the latter has been greater than scarlet fever, the position has materially changed during recent years; this is attributable to the campaign of "immunisation," which has been very successful.

The value of open-air conditions for the treatment of patients in isolation wards is universally recognised, and the design of blocks should provide for the maximum of open-air conditions. Wards with a southern aspect should have large windows so

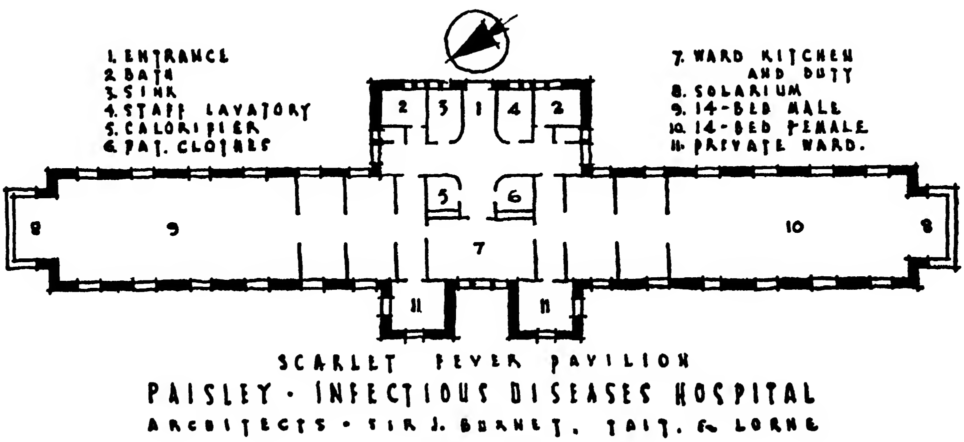


FIG. 168.

arranged that they can supply restricted ventilation or be fully opened to provide almost open-air conditions. Wards on the ground floor should have french windows opening on to a strip of concrete so that beds can at least be partially run out into the open air. When the wards are going to be used for convalescent patients they will be designed accordingly.

Some medical authorities consider that acute infectious cases (e.g. measles) require to be protected from too much light in the isolation wards. As a means of avoiding discomfort to patients from this cause, beds placed against the inner partition walls of the wards so that patients need not necessarily face the windows, overcomes this objection. The provision of suitable sun blinds would be of considerable assistance, and a type of easily adjustable blind, which can be raised or lowered as desired to the required position for protective purposes, is required.

The ancillary rooms given in Chapter 18 will be a useful guide as to the provision required, but somewhat simpler provision will suffice.

A ward office is not usually necessary, and in small ward units a combined duty-room

and ward kitchen is usually regarded as suitable. Each block is run by a sister and three nurses, one of whom would most likely be handy to deal with any troublesome patients, so that the need for observation from the ward kitchen, although desirable, is not necessary.

When both sexes are nursed in the same ward unit duplicate bath and sanitary provision may be required. The placing of the patients' bathrooms and sanitary annexe usually causes diversity of opinion. These units can be situated in the centre portion, which has the merit of being handy for the nursing staff and also leaves the end free to admit sunlight. The antithesis of this opinion has the sanitary block at the ends of the large wards, leaving the ward kitchen in a central position with observation windows to all the wards. An arrangement falling between, is that of having sanitary units projecting to the north from the centres of the large wards.

Bathing infectious patients in isolation wards presents a problem needing special consideration. The practice mostly followed is that of blanket bathing, but provision of bathrooms and fixed baths is also necessary. Portable baths are almost unusable unless there are taps and discharge sluices in each ward. The only valid argument in their favour is that some doctors like to give cool baths to enteric patients. Modern practice appears to be in favour of blanket baths whilst the patient is bedfast and a bath in the bathroom before the patient goes home. It is desirable that the isolation wards should be as near the bathroom as possible and that there should not be a lesser ratio than one bathroom to twelve such wards. These objects can be attained by arranging the wards on each side of a central corridor, adjacent to the bathroom. In a long series of cubicle wards there should be a bathroom at each end.

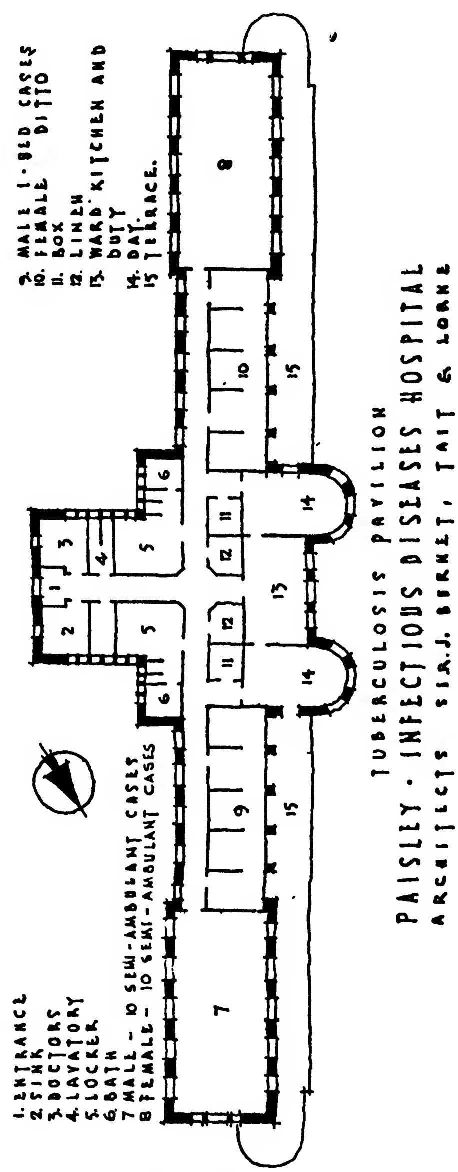


FIG. 169.

Cubicle Wards. Observation being a primary feature of modern infectious diseases, in order to prevent cross-infection cubicle provision became necessary, thus permitting the added facility of being able to deal with other infectious diseases and any

complications. A cubicle ward is used for cases of double infection and doubtful diagnosis and for those diseases of which small numbers of cases are admitted.

Separate cubicles on each side of a central duty-room, from which observation is given through special windows (with plate-glass to obviate distortion) set in the division walls, are the feature of these wards (see Plate XLVIII). All internal doors are flush, with glazed square inspection windows, thus making it possible to see into every room from the corridor without need of entry. In order that adequate supervision from the duty-room may be maintained, there should not be more than six wards on each side of it. Observation windows should be about 7′ wide and 4′ high, the bottom of the panel being about 2′ 6″ from the floor. Observation is further assisted by painting the wards in different colours.

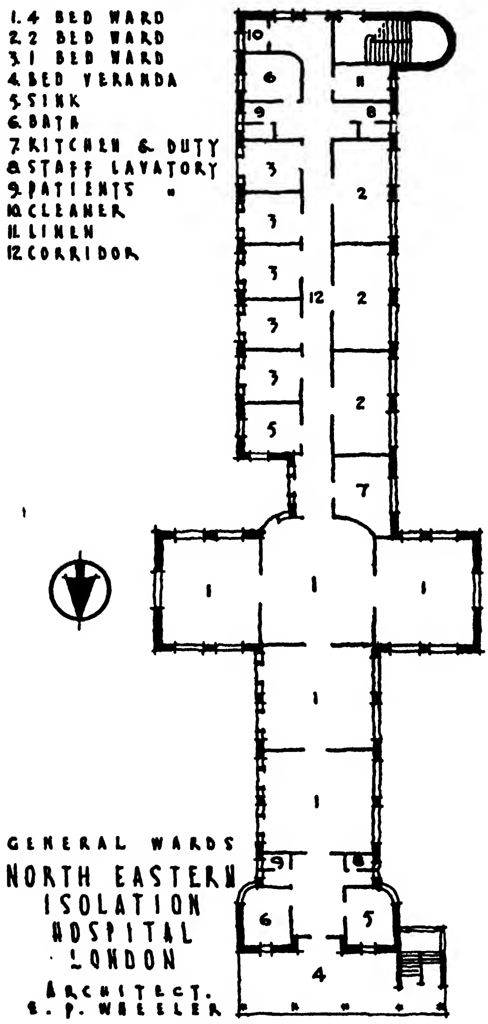


FIG. 170.

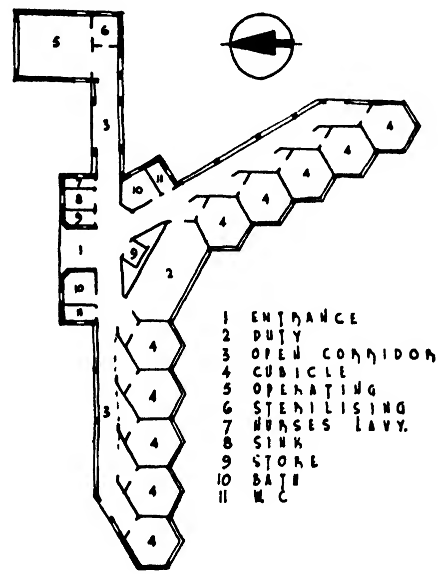
The floor area of single-bed cubicles is fixed by the Ministry of Health, when they are the loan sanctioning authority, at 144 sq. ft., with a clear height of 10′. A complete cubicle block will consist of:

- *a* not more than twelve cubicles
- *b* wash-up
- *c* sterilising-room
- *d* surgeons' lavatory
- *e* patients' clothes
- *f* linen
- *g* staff lavatory
- *h* sink-room
- *i* pantry
- *j* ward kitchen and duty-room
- *k* adults' bathroom
- *l* children's bathroom
- *m* cleaner
- *n* lobby
- *o* anaesthetic lobby
- *p* operating theatre.

The sanitary accommodation should be placed centrally, opposite the duty-room but separated from it by a service corridor. Comment on the theatre suite follows shortly. It is essential that there should be adequate width of corridors and doors to allow of beds being wheeled in and out of the wards with ease. A minimum width of 5′ for the north service corridor is sufficient for the purpose.

In order to diminish the risk of transference of infection, the service corridors are open except for a low wall (see Plate L), and in winter conditions this is somewhat severe on the nursing staff. To mitigate this, sliding windows are sometimes provided for use in inclement weather; but as when quite closed they defeat the object of the open corridor, their use is not to be encouraged. Another useful expedient is to enclose the corridor with wood or steel framing, the upper part glazed and a space about 1′ 6″ high left between the top of the partition and the ceiling; this, again, is protected by a steel and glass over-hanging roof. As the veranda need not be as high as the cubicles, clerestory lighting can be provided, working very much like a typical open-air school, thus providing abundant light and cross-ventilation (see Plate XLIX).

The provision of surgeons' wash-basins is a vexed question. In some schemes a basin is provided in each cubicle, and there are strong advocates for this on the grounds that each cubicle may contain a different disease, and a visiting medical officer or nurse has cleansing facilities, apart from the fact that passage from one cubicle to another would be practically through the outside air. On the other hand the provision of, say, one basin to every three cubicles (see Plate L) placed in a recess in the corridor would appear to be an efficient and economical arrangement, for after all the nurse would rather "scrub up" in a non-infected corridor than in an infected cubicle before passing to another patient. The surgeons' wash-basin will be supplied with hot and cold water from elbow-action taps, the waste being controlled by a knee-action lever. In some isolation cubicles tepid water at 95 deg. to 100 deg. F. is provided to hand basins, thereby needing only one service instead of two. If the practice of placing wash-basins at regular intervals in the service corridor is followed, it will be necessary to protect the pipes from frost. This difficulty can be overcome by the piping being placed on the inside of the ward wall and encased.



CUBICLE WARD
TOLWORTH ISOLATION HOSPITAL
ARCHITECT · P · J · B · HARLAND

FIG. 171.

At Tolworth Isolation Hospital, an unusual design, but pleasing, was adopted (see Fig. 171). Hexagon-shaped rooms have been designed to have no dirt-collecting corners (the wider the angle of wall intersection, the less corner there is, therefore the most perfect shape for these cubicles can be considered to be a circle; but this is obviously impracticable). At Tolworth, only two of the walls are solid—one against which the bed is placed, half facing the windows, and the other in which the door is opening on to the covered way on the north side, which is the only means of access to these cubicle wards;

the remaining four sides are of glass. Two of them are windows to the outside air and form alternative cross-ventilation; either or both of these can be used according to the prevailing wind at the time. The other two are simply dividing the cubicles from each other, and thus form a transparent screen through which all patients can be observed from the duty-room, and towards which the patients' beds face. The whole front is constructed of steel frame and glass. This raises the interesting question of sun-blinds in summer; loose casement curtains, in use in some hospitals, are to be avoided; shop blinds externally are very effective, but they are expensive and can only be used conveniently on single-storey buildings; the ordinary ward screen, when properly manipulated, has been found capable of giving sufficient shade to obviate discomfort to the patient.

The London County Council have erected some two-storey cubicle blocks at the North-Eastern Hospital. There are twenty-eight cubicles on each floor, planned as one

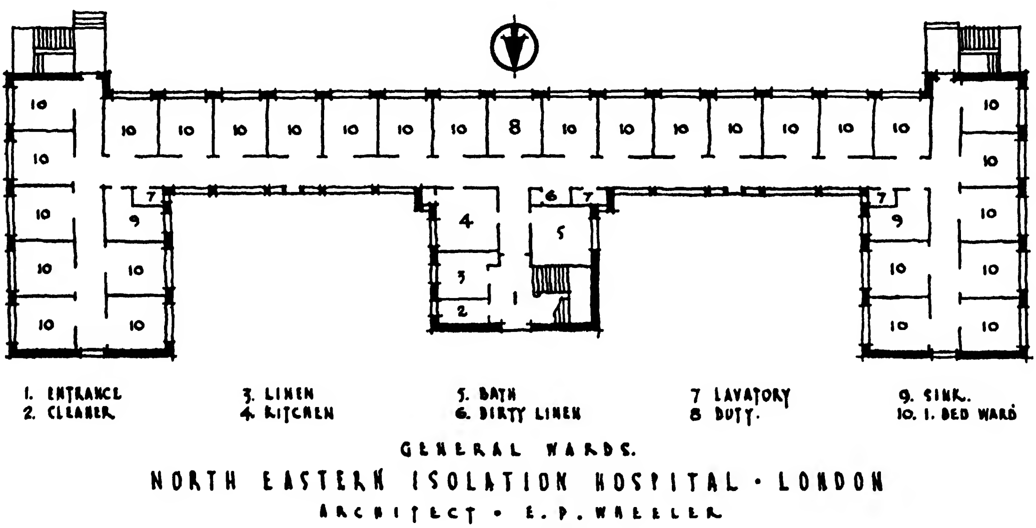


Fig. 172.

unit, with a central duty-room and a central kitchen (see Fig. 172). The end wings have been turned at right angles to the main axis to reduce the length of the block; in these end wings the cubicles are planned on both sides of the corridor, more or less efficient cross-ventilation being obtained by opening lights in the upper part of the glazed screen between cubicles and corridor. The purpose of these wings is to nurse air-borne infection cases, such as measles and chicken-pox, and therefore the doors to these wards have been staggered on opposite sides of the corridor. It must be assumed, of course, that aseptic nursing is carried out in every ward, wing or otherwise; the weak point in the plan appears to be one of administration owing to the difficulty of close supervision of the patients in the wing wards. Another feature of this block is that one wing of each of the double doors to wards is made to swing, with the object of allowing a nurse to push her way through the doorway from either side without using her hands on any part of the door.

Special Departments. An operating suite is essential in every isolation hospital, but it need not be so large and elaborately planned and equipped as that in a general hospital. A simple arrangement is to plan the diphtheria with the cubicle department and then the operating-room can be used for tracheotomy in connection with the diphtheria ward adjoining, but it must be easily accessible from the cubicle and other outlying units. The suite will comprise theatre, sterilising-room, wash-up, and blanket store; no anaesthetising-room, surgeons' room, appliances store, or recovery room is required.

A radio-diagnostic room is also essential, more and more reliance being placed on this help to diagnosis and treatment. A small dark-room is required and possibly a film store also.

These suites can be attached to the cubicle or any other ward units; but there can be no doubt that since the former is for observation and dangerous cases, it should be attached to the cubicle ward by a covered approach, under which the ambulance can unload.

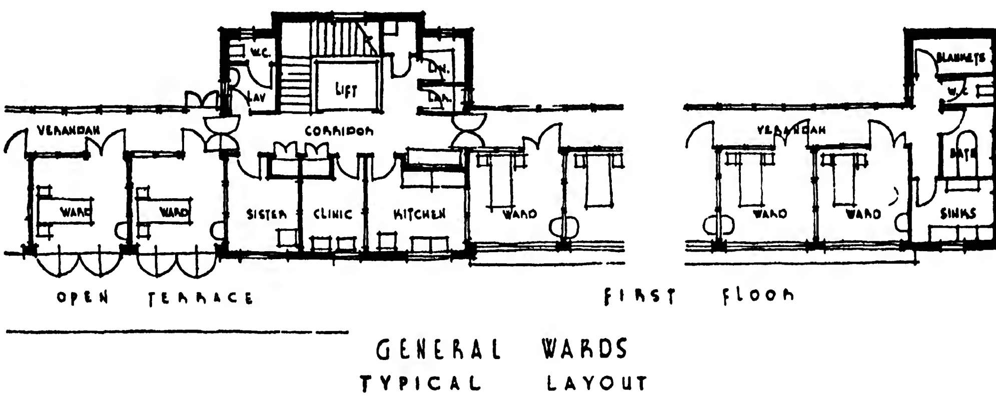


FIG. 173.

Services. Chapter 37 is of general application and will serve as a guide, and here there may be a special case for independent heating of individual ward blocks, as some of the blocks may be only in intermittent occupation.

The normal hospital services are required, with one particular addition—the tracheotomy service. This is a very low-pressure steam service at $\frac{1}{2}$ lb. per sq. in. (constant pressure), which nowadays supersedes the old type of steam kettles, the service terminating in the ward on a swivel arm with lever valve for operation by nurse adjoining the bed, and fitted with telescopic arm for operation at patient's head level in bed. One fitting can be used for two beds as it is fitted with ball joint.

All patients' crockery and cutlery—especially forks—should be sterilised, including enamelled ironware, which is liable to crack and chip. In most hospitals, facilities for sterilisation are quite simply arranged, all that is required being the provision of steam.

SECTION VII

Construction—An appreciation for medical officers and hospital administrators

35

Building Technique

FOR HOSPITAL PATIENTS to gain the full advantage of advanced techniques of medicine, surgery, and science, use must be made of new techniques in the planning and construction of the hospitals themselves. In fact, in the past few years the increased joining of modern hospital efficiency with contemporary treatment methods has reduced the average length of stay in hospitals by more than one-half. In years ahead, in order to limit or reduce the rising cost of hospital care and to meet the demand for the more advanced curative techniques made possible by ever-improving methods of diagnosis and treatment, many hospitals will have to replace their present deteriorating structures and equipment.

"Half workhouse and half jail"—many hospitals still conform all too faithfully to that description. The slightly antiseptic smell that betrays faulty ventilation, the endless half-lit corridors, the dark-brown or green dadoes, and the clattering terrazzo floors—again and again these old mistakes (and many others) have been repeated in buildings erected immediately before the war, because architects, engineers, medical, and administrative staffs fail to study basic needs and to profit intelligently by the experience of others.

As noted in the previous chapters, the structure should be planned on a synthetic and functional basis. The best plan possible for each working unit should be designed—and these units should then be incorporated into a well-integrated complete plan with such adjustments as physical conditions require, but always with due consideration to the operating features of the completed plant.

It is without the province of this study to consider structural features further than to present the relative advantages of certain alternative features concerning which the building committee rather than the architect must decide.

Whatever the architect may do in the design of, for example, a church, he is too often at the mercy of people without taste or knowledge, with the result that terrible and tawdry decorations, uninspired pious pictures, horrid little brass vases, ghastly, and gaudy plaster statues are introduced with a vandalism which is surely just as reprehensible in new as in old buildings. One is really, as things fortunately are, more likely to find an architect's design unspoilt in a hospital. It is simply that the necessity for hygiene keeps out the flummery, and the ordered and disciplined way of life is reflected in an ordered and disciplined building.

ARCHITECTURAL DESIGN

The words "modern architecture" are used here to mean something more particular than contemporary architecture. They are used to mean a new style that looks clean and efficient and not too pompous, and based on the idea called functionalism (or fitness for purpose). Functionalism is not only the custom of building in concrete or with flat roofs; it is quite simple, like all good architecture, the honest product of the science and art. It aims at once more relating methods of building as closely as possible to real need—and in hospital planning the real needs are directed by doctors, nurses, and hospital administrators—to serve modern medical science.

By looking at the task of designing a hospital first as a practical problem that must be solved in a practical way, a problem of accommodating so many people that they can pursue certain activities comfortably, conveniently, and economically, and at the same time with a feeling of pleasure in their surroundings, a new view of architecture can be obtained that puts all the mumbo-jumbo of academic style into its proper perspective. It may be necessary to emphasise that in modern architecture practical considerations are not everything, with beauty compelled to take its chance—on the contrary, the production of beauty is part of the process of design, not an afterthought in the way of applied decoration, and its liveliness and appropriateness is thereby increased.

Moreover, the practical side of modern architecture is not really separable from the aesthetic side, a fact which gives it much of its vitality. Much more than taste is at stake: sheer efficiency, as well as imagination, purpose, vision, are all directed against falsity in architecture, and against the sentimentality that prefers an inconvenient, extravagant, old-fashioned, even obviously ugly building.

The principal reason why a new architecture is coming into existence is that the needs of this age are, in nearly every case, totally different from the needs of the previous ages, and so cannot be satisfied by methods of building that belong to any age but the present. They can be satisfied in the practical sense, by utilising modern building technique and modern scientific inventions to the full. They can be satisfied in the aesthetic sense both by honest craftsmanship in our own materials and by taking special advantage of the opportunities these materials offer of creating effects and qualities in tune with the times. For example, instead of grafting antique ornaments on to new structures, or clothing a modern steel-frame structure in a mass of masonry, these timid expedients are displaced by making the most of precision and machine finish that is so characteristic of modern technique.

Modern architecture in Great Britain has never had the benefit of official encouragement, as it had in the Scandinavian countries, for example, and as it had in Germany and Czechoslovakia. On the contrary, it has always been, until quite recently, the official architecture that has been most backward. Not only does this apply to the work done by the official architectural offices, but also to work done by private architects for municipal and other authorities.

Already in the eighteenth century a high standard of design was set by the cultivated taste of an aristocracy. Though our modern bureaucracy, which acts in the same capacity, has not yet succeeded in acquiring definite enough standards of modern architecture of its own to exert an influence, we have the benefit of some equivalent, namely, that of certain big public and industrial corporations. One only has to cite the example of the London Transport Board, whose good influence on design is incalculable. Not only are its underground stations—often placed in instructive contrast to their surroundings—the most satisfactory series of modern buildings in Britain, but all the details of their equipment—signs, lettering, staircases—are well thought out and in a consistent modern taste.

Much of the unexpectedness of modern architecture is due to the new materials that have become available during the last half century. The inventions of science can be used either to do the old things more conveniently or cheaply or to do things that could not be done before.

Throughout history both the general appearance of buildings and their style have been determined by the knowledge of building technique available, as well as by the materials used and the tools with which they were worked, and, of course, by fashion and taste. We know more exactly than our ancestors how materials behave in different circumstances, and a number of new materials have been invented or discovered. But neither the introduction of new materials such as reinforced concrete nor the advent of all the mechanical aids to comfortable living, such as air-conditioning and refrigerators in which we are so rich to-day—both results of modern industrial economy—has produced a revolution in architectural construction. Modern architecture is conditioned by the same sort of factors.

One thing which has made modern architecture different in kind from the architecture of the past is its connection with modern industry, particularly with its dependence on power of production, namely the factory system. The actual labour of producing the parts of a building is now centred in the factories, instead of being left in the hands of the individual workmen. At one time the workmen arrived on the site of a proposed building with all their raw materials, and the tools to shape them with—stone or timber for the walls, more timber for the floors, doors, and windows, lime for plastering the walls—and they constructed the building on the spot, manufacturing as they went along whatever was needed in the way of doors and windows, sometimes even quarrying stone, clay, or sand on the site. Later, for convenience, the doors and window-frames were made in the builder's joinery shops and so on. The first important example of what is now called "prefabrication"—that is, the manufacture of ready-made building parts—was the brick industry; since then, factories have become the normal way of making most things. To-day, a large portion of building jobs is done in the factory; the windows arrive ready-made; so do steel beams, doors and sinks, baths and all equipment. The erection of a building is being changed into a process of assembling ready-made parts, and it will go much further even than it has to-day.

The practical advantages of prefabrication are two-fold:

a it is quicker

b it does away with uncertainty.

Speed in building is important these days because of the high cost of land; the time during which such an expensive commodity is out of use must be reduced to a minimum. And partly or wholly prefabricated methods of construction save time on the job, not only because everything is ready in the factory beforehand, but because prefabrication means a change-over from wet to dry construction. Prefabrication does away with uncertainty, because it means that the whole building is made of standard parts whose behaviour is known and has been tested. Any defective part can be replaced and there is no uncertainty whether this or that feature of the building will work satisfactorily. That is how factory production affects building technique.

CONSTRUCTION

It is not intended to discuss or to attempt to describe the older types of traditional building, but only to refer to the essential constructional idiosyncrasies of hospital construction.

It may be said generally that the choice of constructional forms should not be restricted in any way in the building of hospitals. The spans, loads, and heights are generally of a very medium range, and these considerations would not therefore be expected to limit the types of construction which are available.

Apart from any special circumstances which may influence a decision, the points of obvious major importance in selecting the types of construction to be used are:

a strength

b resistance to weather

c suitability for purpose

d cost in building

e cost in maintenance (painting and repairs)

f running costs, such as heating, which would be influenced by the thermal insulating properties of the construction.

It is evident that it is not possible to fulfil all the above requirements, using traditional forms of construction, without involving considerable cost in building. Pre-war developments in constructional design have, however, made this more possible, and the forms of building available, although not all of permanent construction, are considered to have an adequate useful life.

The question of permanency is one upon which hospital committees must make a decision. It must be recognised that many hospitals built less than 20 years ago are now out of date both in planning and accommodation and fittings. It is probably safe to surmise that the same will be the case in the future; and a building with a useful life of 20 years, costing less than a building of more durable construction, would therefore be an advantage.

There are three principal methods of construction and they may be classified:

a Permanent construction. This would apply to buildings (commonly of multiple-storey type) substantially constructed in brick, stone, steel, and concrete in various combinations. Buildings of this character may be assumed to have a life of centuries.

b Light, fire-resisting construction, sometimes called semi-permanent. They would be of steel-frame type, with relatively thin outer walling of possibly hollow construction in two thicknesses of brick or concrete slabs. Internal finishings would be similar to (*a*). This class is particularly suitable for low buildings of one or two storeys, though not restricted thereto.

c Temporary construction. Buildings of this class would generally be of wood or wood and slab construction. On the outside they would have a weather-resisting finish such as galvanised-iron or weather-boarding. Inside they could be finished in various materials, e.g. boarding, asbestos, or other sheeting or plaster. Certain sections of a hospital of this class of construction (sanitary units for example) would require to be in more substantial form. The life of a building of this type depends on the care devoted to its maintenance, and if well maintained it may reach 50 years. It is not considered that this type of construction would be appropriate, under normal conditions, to meet the requirements of the treatment of the sick or adequately to provide against fire risks, and this method of construction should not be adopted except in grave emergency.

The preconceived idea that semi-permanent construction must be of a somewhat "inferior" appearance must be refuted. Semi-permanent construction offers equal opportunities for good design as do other forms, and there are numerous finishes available. The permanent type of construction on the lines formerly and commonly applied to hospital buildings is not favoured, except where conditions may render this imperative or the best course economically. Buildings of one or two storeys and of low height naturally lend themselves to a lighter and more economical form of solid construction.

Buildings of one storey of the light, fire-resisting type referred to in (*b*) above could be erected to last a minimum of 30 years, but more probably 60 years would be the effective life, after which period they could, if necessary, be modified or rebuilt in the light of later developments of hospital architecture and equipment. Although vertical blocks of several storeys may have to be heavier and of more substantial construction than low buildings, they also are still bound to become out-of-date in the course of time. Experience shows that temporary and permanent buildings tend to last for a longer period than was originally expected.

Questions relating to construction can, however, best be considered, and conclusions arrived at thereon, when the general arrangement and principles for development have been reviewed and decided.

The extent to which experience of large-scale bombing may suggest modifications of

building practice in the post-war period is at this stage purely speculation. It will inevitably depend largely upon political conditions of the peace whether or not post-war buildings will be largely influenced by decision for increased protection. If this is the case, shelter protection and structural resistence to bombing may become an integral part of hospital design. The ramifications of the effect of an "armed peace" upon building technique may well be considerable.

If general protection from the effects of aerial attack should be demanded, it is essential that a clear differentiation be made between protection of structures and of personnel. Whether the erection of structures capable of resisting blast and splinter penetration is desirable or not is a debatable point. In the first place, development in indestructible methods is more or less a progressing evolution, and it is questionable whether blast or splinter protection of the order generally agreed to-day would necessarily be much good in a few years' time. The cost of producing structures to withstand blast and splinter would not be favourable, and a semi-bomb-resistant structure might well encourage a false sense of security.

In view of these circumstances, therefore, it might be reasonable to suggest that while the introduction of a high level of resistance to fire would seem a most worth-while measure in order to effect some reduction in the possibility of being damaged by aerial attack, attempts to provide either personnel protection in hospitals (other than by shelters) or any high-level of resistance to bomb damage on the part of the structures themselves would be economically impracticable.

A necessarily important part of post-war hospital planning will be the evolution of carefully worked out minimum standards and investigation into minima generally. Optimum economy and efficiency in hospital arrangements may also be achieved if, parallel with technical developments relating to structural systems and building organisation, ideas about accommodation requirements are thoroughly revised and brought up to date.

Reduction in the quality of materials and workmanship is not necessarily undesirable. Too great permanence—resulting in structures long outliving their primary period of usefulness—can have many unsatisfactory effects upon architectural development. What is necessary is that, as far as practical considerations of stability, etc. allow, the amortisation period of a structure should be approximately determined at the time of design, and adjusted as far as possible in accordance with an organised development programme.

Discussion of financial manipulations is virtually outside the scope of this book, but it is to be expected that, given extended national organisation in the building industry, facilities for overcoming these problems will be developed upon a sounder basis than before.

It is rarely possible either to determine the potential life of a structure or to base structural design upon these considerations with anything like the degree of accuracy which would be desirable. In connection with most types of building, stability and insulation requirements primarily determine the character of the fabric; a few, if any,

buildings may have their structural design determined primarily upon "life" requirements. The most satisfactory method of determining structural minima would seem to be:

a upon the minimum framework required to give the necessary stability, carefully related with regard to safety factors in view of the margin of error of the structural systems due to operatives and materials employed: the greatest need here is that those regulations controlling building should fully take into consideration the effect of mechanical construction and precision manufacture upon the occurrence of errors;

b upon carefully estimated insulation requirements (heat or sound), taking into consideration the exact purpose of the structure;

c upon the degree of weather resistance required and for how long.

It may be easily appreciated that the last factor is the one primarily to determine amortisation, since failure of weather-resistance is likely to occur long before instability due to structural decay, and that—generally speaking—failure of insulation is likely to be more or less contingent upon such failure.

The optimum application of the principle of standardisation should relate to many aspects of hospital organisation. The preparation of projects fully exploiting the possibilities of standardisation, and the possibility of obtaining wide variations in plan form, amenity, and even aesthetic character within a basic framework of standardised building elements, is a very real one. While it is possible for a certain measure of prefabrication to be carried out without particularly conscious or premeditated standardisation, standardisation is essentially an integral part of any scheme for extensive prefabrication.

Where standardisation is concerned with the large prefabricated elements of a highly systematised building scheme, some departure from general standards would be permissible. This might at first sight appear anomalous, but where a structural type is to be considered as a whole, for constant repetition as a whole, the maximum co-ordination between component parts of that type should be aimed at. In this connection, departure from general standards would be permissible, but whenever possible co-ordination should be maintained. An impartial survey of the hospital planning will reveal that certain parts are often quite unnecessarily freakish. Sink-rooms, sluice-rooms, duty-rooms, and similar parts are basically utilitarian, and may be designed, with almost mathematical precision, to conform to certain specific requirements. The standardisation of these elements is an obvious step.

In the case of buildings other than small houses, standardisation was often, under pre-war conditions, impracticable owing to siting eccentricities. Many public utility buildings could not be standardised to the last detail simply because no authority was in a position to acquire the necessary conformity of siting to make this possible. Under post-war conditions, where large-scale rebuilding has become necessary, much of this difficulty has disappeared owing to complete replanning of sites. In hospital planning

generally, freak siting will rarely occur, and even the smallest-scale standardisation project should provide sufficient variety of type to meet variations in orientation and view.

Where the design of fittings and equipment proceeds parallel with the evolution of a specific standardised structure, there is some excuse for departure from general standards, as in the case of prefabricated structural elements. Moreover, this is particularly permissible where the fitting is an almost integral part of the structure and where it has an expected life approximately that of the rest of the building. However, when maintenance is likely—such as would be the case with heating installations and other mechanical equipment—it is desirable that the plant should conform to accepted standard practice in all possible ways.

There are many respects in which proprietory products could, and should, conform to recognised standards. Sanitary fittings and other equipment often vary unnecessarily in overall dimensions, principally due to manufacturers' proprietory devices. These are being standardised to facilitate replacement, so it is quite possible to conform to certain rooms.

The outstanding problem is securing a reduction in building cost without impairing the efficiency of the buildings, with particular reference to capital cost of construction and annual cost of maintenance. Economies in specification and the cost of actual building had, in pre-war years, been carried to such a point that very little reduction was possible. The two fields that offer possibilities of success in this direction are the elimination of superfluous materials and processes or a change of methods of planning.

Reinforced concrete, according to modern technique, can be utilised, at one and the same time, as a weight-carrying medium, a shell to protect the buildings against the elements, and as a decorative treatment, both internally and externally. This threefold use of a material should show economy over a design employing a different material for each purpose, each having to be carried in turn by the others.

Not unnaturally, architects are disinclined to risk their clients' money and their own reputations by departing from well-established methods of building in favour of a new alternative, before the latter has been proved to be less expensive and not less satisfactory. Nevertheless, owing to the scarcity of traditional materials at the conclusion of hostilities, alternative materials now have to be used before they have been fully tested, and the wisdom of a cautious attitude and the need for careful scrutiny of the claims of inventors and others experimenting in the use of new materials, must be set aside for a few years.

It should be remembered that annual costs of maintenance and operation are of even more importance economically than first cost. A hospital once built lasts for very many years. Interest on capital and sinking fund charges form only a comparatively small proportion of the total annual expenditure. This is no excuse for extravagance in construction, but is mentioned as a reminder that reductions in first cost may be the reverse of economy if they tend to increase costs of operation or maintenance or to impair efficiency.

One often hears of "modern methods of construction," and this is understood to mean any form of construction that has come into use within a generation, and would therefore include:

a reinforced concrete in its various forms
b steel or reinforced concrete frame and panel construction
c a number of new insulating materials, and materials for finishing walls and floors, all of which are well known to the practising architect.

The Report stated that, from the evidence submitted, it came to the conclusion that while there are some useful alternatives to traditional methods of construction, there is no new material or method of general application that is likely to lead to a substantial saving in cost, and careful designing with due regard to economy in material and avoidance of elaborate architectural detail offers the best means of reducing cost.

Post-war reconstruction is urgent, must be economical, and must be contemporary. War-time developments are likely to have considerable direct and indirect effect upon post-war building and construction. The value of such progress in building organisation and technical development as has resulted from war-time demands must be fully exploited for post-war requirements.

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Methods and Materials

A HOSPITAL TO BE effective requires the most careful attention to details. Every working detail is important, and on account of the purpose it has to serve, it must be scrupulously designed in what might be called minimum terms. Certain factors govern hospital design, namely, a strict necessity for economy because the normal cost of hospital construction is high; a need for sanitary, durable finishes; an unusual emphasis on adequate natural lighting and exposure; the necessity for economical plant operation; and a pattern of recognisable functions.

The following suggestions may be regarded as a general standard to be adopted, from which, however, specific variations can be considered where circumstances or special conditions render them desirable. It should be borne in mind that, in regard to State-aided hospitals, the policy of the Minister of Health is, so far as possible, to restrict public expenditure to essential requirements. While there may be a difference of opinion as to the desirability, or otherwise, of adopting alternative systems to that of ordinary brickwork and normal construction, no objection will be raised by the Minister to the adoption of suitable alternatives, subject to the necessary safeguards as to the avoidance of risk of life in the event of fire. All such proposals, if made in the interest of economy, will have sympathetic consideration.

It must be remembered that every age is, to some degree, an age of revolution as well as an age of discovery. In this generation it is being discovered that quantity is not enough to make a real civilisation, quality is of equal importance. It is the brains behind the machines which really matter.

CARCASE

Steel and Concrete. The most important of the modern materials are structural steel and reinforced concrete. It is necessary to stress the adjectives "structural" and "reinforced," because steel as a material was, of course, known for centuries before it was applied to building, and concrete, in the form of masses of solid walling made by mixing stones and cement, was used widely by the Romans.

The form in which steel is most commonly used, both as beams and stanchions, is that of an "I" consisting of thick flanges kept apart by a thinner strip or web. This shape, which is produced in rolling mills by passing the steel through shaped rollers, resists the various stresses set up in a beam, while using the minimum of material.

France can claim that she not only gave modern architecture its favourite structural material, reinforced concrete, but showed how it should be used. As its name implies, it is a composite material. The point of it is this: concrete by itself—which is really a kind of stone manufactured by mixing cement and sand with ballast and allowing it to set—is very strong, just as stone is, from the point of view of the direct weight it will stand, but it is relatively weak in other ways: it will soon fracture under any kind of stress other than direct weight. Now a beam spanning between two points—the commonest structural form—the top surface is being compressed and the bottom surface stretched, and in plain concrete the upper half will stand any amount of compression, but the lower half will soon break apart, as its tensile strength is weak. What is needed is some way of increasing the tensile strength of the lower part of the beam to equal the natural compressive strength in the upper part—this is done by embedding steel rods in appropriate positions in the lower half, steel being a material that is equally strong in compression and in tension. Reinforced concrete, therefore, is a material combining the crushing strength (and the ease with which it can be cast in any desired strength) of concrete with the tensile strength of steel, and all reinforced concrete structures are only an elaboration of this principle, though some are exceedingly complex. The most obvious advantage of steel and reinforced concrete is that they will span very great distances—this enables large spaces to be covered in easily and economically.

The use of steel and reinforced concrete has brought about another even more radical change in the conception of architecture. The normal way of using either of these materials is as a framework or skeleton: this means that weight-bearing walls disappear. The weight of floors and roofs is taken by the structural skeleton, and the walls become screens whose purpose is to enclose the space within, to keep out the weather, and to keep out sound; the whole building, indeed, as its weight is transferred to the ground only at a few small points, can be raised on these as on legs, so that the garden or road passes right underneath it. In fact, the disappearance of the solid, weight-bearing wall has introduced a new flexibility into planning, as walls and partitions can be pushed about independently of a few points of support.

Reinforced concrete construction can be used throughout, consisting of columns, beams, cantilevers, and external walls, which allow uninterrupted floor and window areas and give complete immunity from fire risk in the main structure. To reduce initial cost the blocks that form the inner lining of the external walls can be used as shuttering for the concrete, so that little more than half the wooden or steel shuttering normally employed in a concrete building is necessary for these walls. The blocks are selected for their resistance to heat and cold transmission, and the same type of block used for the internal partitions provides equally good resistance to sound transmission. No internal walls should be structural, so that if necessary rooms can be enlarged and altered in the future at little cost and without interference with the stability of the building. The reinforced concrete flat roofs can be finished with special tile, insulating the building against excessive heat and cold, and the floors of hollow construction with suspended ceilings to guard against sound transmission.

Before leaving the subject of reinforced concrete, there is one more aspect of it that should be mentioned. It is the question of surface treatment—important because that is one aspect of modern building technique that is still very much in a transitional phase. Concrete walls—their slabs of reinforced concrete spanning between the structural framework and continuous with it—are a common form of construction, but how unsatisfactory the external appearance often is! The cleanliness and glitter of white walls seldom survive in the British climate—they soon become dingy—but there are a number of admirable ways of surfacing a concrete building, including coloured tiles or glass. These materials being non-porous, dirt easily washes off, but they are both expensive. An important matter in this respect is the design of guard rails and the like to throw off water and not stain the walls.

Walls. The thickness of all walls should not be more than is necessary to ensure the dryness of the interior of the building and the stability of the structures. In the latter respect, the introduction of piers or columns to carry the chief loads will usually result in economy.

The Report considered methods of construction and found that for external walls of buildings of one storey, some form of pier and light panel construction would be appropriate and economical. For two or four storey buildings, normal brick construction is stated to be the most economical, and steel or reinforced concrete frame-and-panel construction for buildings above six storeys. When deciding on the type of external walls to be adopted, the space required for concealed vertical heating pipes, water-pipes, and possibly waste pipes, must be borne in mind, especially in frame construction.

Stonework or other expensive material should not be used for mere decoration, but artificial or reconstructed stone may, in most circumstances, be used with economy as a substitute for natural stone where necessary. Where the bricks available permit the use of picked stocks or common bricks for outside facing purposes, they should be used in preference to special facing bricks.

In view of the possibility of a rearrangement of the accommodation in a hospital being required at some future date, internal walls, except those surrounding staircases and lift shafts, should be built as partitions, rather than as structural or weight-carrying walls. Steel and glass, hollow-burnt clay blocks, or light-weight concrete may be used for partitions, but solid brick or some form of double partition, insulated at the edges, is required where the avoidance of the passage of sound from one room to another is important. The partitions should be placed on strips of bituminous felt to prevent vibrations reaching the floor.

Floors. The upper floors of all buildings occupied by patients and staff should be of fire-proof construction. This also applies to the ceiling of top floor.

In the selection of one of the many types of fire-resisting floor available, economy must be considered. It should be borne in mind that the use of a thick floor will affect the height of the building and the consequent cost, and while a thick floor may have

the advantage of lessening the transmission of sound, which is an important consideration, a thin floor, supported by structural beams projecting below the surface of the ceiling, is no real disadvantage. One of the most economical floors is that of reinforced concrete continuous over the supports; surfaces of the floors can be insulated with layers of granulated cork immediately over the concrete floor, covered with $\frac{3}{4}''$ cement screed; linoleum is then stuck to the floor with a reliable cement. In this way, any vibrations which reach the screed will be damped by the elastic layers underneath, and the bigger mass provided in the concrete floor will not be set in motion.

The ordinary wood-joisted floor on sleeper walls is satisfactory for ground floors of wards and many other parts of a hospital. It is economical and provides convenient space for the running of pipes, cables, etc. Where a ground floor of concrete is to be covered with linoleum or other similar material, it should be constructed as a suspended floor.

A smooth ceiling finish is usual, but in suitable positions economy can be effected by the acceptance of an uneven surface such as would be obtained by applying paint direct to the tile soffit of a fire-resisting floor.

Roofs. These can be either of the flat type or pitched type. The former are now almost universal for hospitals, although the latter are essential and must be provided for mental colonies. By the adoption of the flat roof, greater freedom in planning may be conferred by release from the restrictions imposed on the shape of a building by a pitched roof. The pitched roof has the advantage over the flat roof in that it provides convenient space for tanks, water pipes, etc.

When the roofs are of the flat type, they can be of solid concrete or precast flooring construction, covered with a layer of 1″ expanded and compressed cork in slabs 2′ by 1′, stuck to the main construction with bituminous emulsion. The falls are obtained by sloping concrete in order to economise in screed. Over the cork two layers of bituminous felt embedded in asphalt mastic are laid to falls, and the whole is covered by $\frac{1}{2}''$ of tarmacadam with a fine aggregate. In order to reduce the intensity of the sun heat on the black, absorbing surface of the tarmacadam, thus over-heating the top-floor rooms, a special layer of Derbyshire spar can be applied to the macadam, which leaves its surface permanently light coloured.

When the roofs are used as terraces by the patients, they should be finished with Parapo or similar tiles. When roofs are covered with lead, there are 2″ rolls at frequent intervals, and the necessity for deep gutters makes the ordinary lead flat impracticable for traffic. A flush surface is obtained by laying 2′ square tiles butt-jointed between the rolls.

When the roofs are of the pitched type, the pitch of the roof should be reduced as much as possible, to suit the type of roof covering to be used. Projecting eaves and gutters are desirable, but the projection should be of moderate dimensions, merely to ensure that faulty gutters can be detected and readily repaired. The soffits of eaves should be covered with inexpensive material not requiring frequent repainting.

Staircases. These should be of fire-resisting materials, preferably of reinforced concrete, or alternatively of artificial stone with special non-slip insets, and nosings. The balustrade may also be of solid construction.

The landings to alternative means of escape stairs should have glazed screens, to prevent the spread of smoke in the event of fire, with doors opening outwards. The doors and glass screens will all be of fire-resisting materials.

The design of stairways has been reviewed in Chapter 5.

Windows. Natural ventilation is considered the only satisfactory system for hospitals in Great Britain, and the problem is to design a window which will admit a small amount of air without causing draught in cold weather, and which can be opened to full extent in warm weather. The movement of air is almost as important a factor as sunlight.

The various types of hospital windows are:

- *a* sash windows: have boxes where germs may breed, and cords or even metal chains can break; can only be opened 50 per cent. and let in rain;
- *b* louvred Austral type: when falling open, intercept the sun's rays, as all ordinary glass is impermeable to ultra-violet rays;
- *c* ideal hospital window is one in which the upper fourth is horizontally centre-hung, the bottom fourth is bottom-hung to open inwards and the centre half is side-hung to open outwards (see Fig. 94). Every part of the window can be cleaned from the inside, 50 per cent. can be opened even when wind and rain are driving against it, and in fine weather the unobstructed ultra-violet rays can be let in through one-half of the window area;
- *d* as an alternative to (*c*), for use with the longitudinal bed layout, is the sliding-folding concertina type. This is attractive in this form, gives a sense of space, and the large free openings are a delight in fine weather; the sliding-folding sashes can be made with upper portion centre-hung and lower portion centre-hung or bottom-hung (see Fig. 94); the bottom portion is necessary to prevent dust blowing into the ward from the outside sill;
- *e* a further alternative type is a window with fixed bottom sash and horizontally centre-hung upper sashes.

In designing a window, the following principal points should never be lost sight of, and unless a window meets these requirements it cannot be said to be suitable for a hospital:

- *a* accessibility for cleaning;
- *b* prevention of rust, normally by paint; when the buildings are near the sea, the windows should be of heavy steel section, cadonium-zinc sprayed throughout as a protection against the corrosive action of seaside air;
- *c* easy to clean from the inside, and should have the minimum number of bars and angles in which dirt can collect;

d for high windows and casement doors, espagnolette type of bolts should be used, so that no bolt is out of easy reach (see Fig. 174).

After considering the advantages and disadvantages of various materials, it appears that metal windows are the most suitable, and they have the added advantage of assisting in fulfilling the desire for large glass area. High blocks with large windows (such as staircases) should be provided with a metal cornice, providing a hanging for window-cleaning cradles.

The use of steel and concrete construction to span wide openings has had a direct result on window design. To-day there are numerous kinds of folding and sliding metal windows to fit these wide openings, notably the kind that both slides and folds up like a concertina, so that the whole of the window, possibly running the length of the room, can be thrown open to the air.

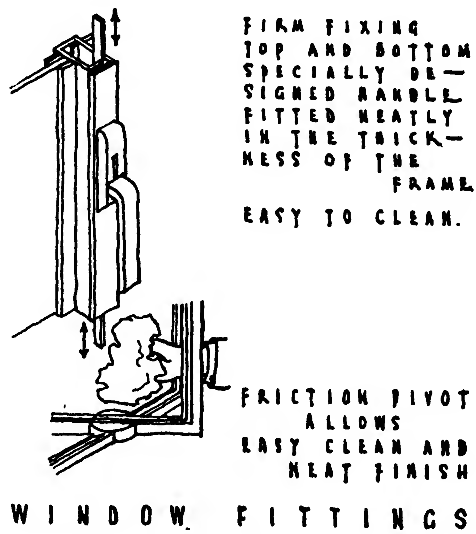


FIG. 174.

In consideration of the hard wear put to window-sills, they should be of tile, as they are easily washed. In lieu of tile, they can be of polished hardwood or metal; the latter, with a special profile, can be fixed with the underside filled in with composition in order to make them sound proof.

Glass. The glass should be selected for its reduction of heat losses in cold weather and insulation against solar radiant heat, and for easily cleaned flat and polished surfaces on each side.

The London County Council carefully considered whether any therapeutic advantages were to be gained by the introduction of ultra-violet glazing ("Vita" glass) in hospital wards in London, particularly in relation to the treatment of certain ailments in which exposure to sunlight and ultra-violet rays is indicated, and arrived at the conclusion that the type of glazing in the present state does not, in London, justify the additional cost. The main reasons given are:

a ultra-violet rays are of use only if received directly on the naked skin: therefore, for patients lying under bed-clothes no advantage could be gained;

b it is understood that ultra-violet glass degenerates, by a process known as "solarisation," to such a degree that its permeability decreases by about 30 per cent. in six months;

c the cost—several times as much as ordinary glass;

d if ultra-violet treatment is needed in London, where the smoke-screen absorbs

a proportion of these rays, it is better to give it as a direct therapeutic measure by graduated and time exposures to the direct sun or, preferably, to an artificial source of ultra-violet light; the latter source is preferable because of the difficulties which arise in connection with the former method as a result of the vagaries of our climate.

The objections to Vita-glass do not, however, apply to the same extent to country hospitals and the late Sir Henry Gauvain in his report of 1931 to the Trustees of the Lord Mayor Treloar's Hospital, Alton, advocated its use.

"Thermolina" glass is the most suitable for the glazing of operating theatres and ancillary rooms, and to ward screens, because it combines complete light diffusion providing freedom from glare, adequate observation, and a pleasing appearance.

INTERNAL EQUIPMENT

The provision of adequate and accessible ducts for services throughout a hospital should be a factor foremost in the planners' minds from the very early stages. All too often the services are crowded together in vertical and horizontal slits in the building, making maintenance work almost impossible and harbouring vermin. "Put all your pipes on the surface—never have ducts" is common advice given by the staffs of new hospital buildings. To follow this advice is more sensible than to provide inadequate housing for services; but maintenance is inevitable and ducts can be planned to give accessible and satisfactory concealment. The ideal duct may be a vertical series of rooms in which the service pipes and conduits are on the surface of the walls, and where a fitter can go into the room through a door, shut himself in, and carry out his job without dirt or disturbance. The floors of these ducts could be of open steel flooring similar to that used in a ship's engine-room, access vertically being by cat ladders with exit to the building at each floor level. Fire-risk in such a vertical working duct must be minimised by automatic protection. There is a disadvantage: see "Acoustical Treatment" in this Chapter.

Unless the services are concentrated at a very few places in the building, this ideal would be expensive, but—within practical limitations—it is an ideal at which to aim. The almost universal practice of running services overhead or below floor level in the corridors is to be discouraged.

Floor Materials. There is no "best" floor finish for hospitals. Every floor material has its own advantages and disadvantages, and the conditions of service in the hospital are so varied that it is customary to use five or six different types of floor materials according to the conditions to be expected in each particular area.

Some areas need moisture resistance, others need chemical or oil resistance, others need resilient materials for noise reduction, some need heavy-duty wear resistance, and in some cases decoration effects may be considered paramount.

The one floor material most generally useful in the hospital is linoleum, either in

sheet form (battleship grade) or in tile form, and either in solid colours, usually either sealing-wax brown or green, or in patterns, usually in marble effects.

Linoleum is generally laid on a cement foundation, the skirting and cove being carried out from the wall a sufficient distance to form an attractive border. To add resilience and to prevent unevenness of the base showing through to the surface it is advisable to underlay the linoleum with one, or better two, layers of linoleum felt each separately cemented to its base. In many areas, especially corridors and heavy traffic areas, the tile form is often preferred, as by using two or more patterns of tile more attractive effects are possible and traffic marks are less evident. The joints are the most vulnerable points in a linoleum floor and for this reason many administrators prefer the sheet form.

On account of its resilience, linoleum is usually preferred for corridors in the patient areas, in working spaces such as offices, in dining-rooms, and in patients rooms. In one instance in America, a hospital having large open wards, a 6′ traffic strip of linoleum was laid down the centre of the ward, the sides where the beds stand being terrazzo. In all cases in hospital use the battleship grade of linoleum in a thickness of not less than $\frac{3}{16}$ in. has been shown by hospital experience to be the most satisfactory type.

Some administrators prefer rubber tile for corridors and office spaces, particularly since the maintenance cost is very much less than for linoleum. Rubber tile is, however, much more expensive than linoleum on first cost, and is usually available in the tile form only.

Another material often recommended for areas where a resilient floor is desired is asphalt or an asbestos tile. This is only moderately expensive in first cost and less expensive than linoleum in maintenance. The choice of patterns is somewhat limited and the material is very sensitive to temperature, becoming soft at high temperatures sometimes occurring in the hospital and brittle at temperatures sometimes occurring in an unoccupied room. Some of this material is more resistant to oils and stains than is linoleum, and is therefore at times preferred for laboratory and similar areas.

Of the hard surfaced floors, terrazzo is the most popular. Terrazzo is simply marble chips in cement and the surface ground to a polished finish. Terrazzo has the advantage of wear resistance equal to concrete, economy of installation and upkeep, and by variations in the type of marble chips used, a satisfactory range of colour effects. It has somewhat less stain resistance, but the pattern is so broken that small stains are not noticeable, and even when defaced many can be bleached out. The principal objection to terrazzo is that building settlement practically always results in cracks which are both defacing and somewhat unsanitary. Terrazzo is usually used in corridors, public areas, sluices, and theatres and their ancillary rooms. Despite the economy of its maintenance it still has the defects common to all hard-surface floors in that it is cold, hard to walk or work on, and is noisy.

Areas subject to a great deal of wetting require a moisture-resistant surface. For such areas, notably bathrooms, closets, sluice-rooms, and sometimes ward kitchens, a glazed tile either all white or laid in patterns is commonly preferred except that in

ward kitchens and sluice-rooms the non-slip characteristics of the so-called egg-shell finish tile give it a preference. For central kitchens red quarry tiles have the preference.

If more decorative treatments are desired for lobbies or similar public spaces, such materials as Travertine or similar marbles have sometimes been used, but the practice is decreasing. Cork tile has been used in areas in which quiet and easy walking are of paramount importance. These floors are comparatively economical to maintain, but are also subject to pitting by desk legs and similar heavy weights.

When any resilient floor material is used it is customary to countersink it in the concrete or terrazzo to a sufficient depth to bring the adjoining surfaces flush with each other. The apron is usually of terrazzo, the apron and the skirting of the wall being cast in one piece. The meeting-point of apron and skirting is usually finished as a cove formed on a radius of, say, $\frac{1}{2}''$. In corridors where wheeled traffic, such as trolleys, wheel-chairs, etc., is heavy, there is need for some protection of the walls against scarring by careless traffic (see Chapter 5).

Lighting. Lighting in the hospital involves much more than merely being able to see properly; there are also bactericidal and psychological effects of light to be considered. These are frequently inseparable and involve both natural and artificial sources.

The characteristics of good lighting, both natural and artificial, are:

- *a* even distribution
- *b* absence of glare
- *c* absence of any too bright source of light.

For wards with the usual window openings and areas, the illuminations will probably vary from a few hundred foot-candles near the windows to ten foot-candles, or less, near the opposite wall if there are no windows; while the illumination out of doors, even on a cloudy day, may average five hundred to one thousand foot-candles or more.

It will be seen, therefore, that present ward lighting falls very short of that which exists under the open sky. The human eye evolves under the high values of illumination which are present out of doors by day. It may appear, therefore, regrettable that the human eye, while required perforce to remain indoors, should not be able to enjoy the natural light available, at any rate to a very much greater extent than it does at present in wards. The present design of hospital windows, while satisfying the needs of ventilation, is obviously not performing its chief duty as it should. The direct light of the sky is restricted to a small area near the windows, most of the light available being shut off by the ceiling and the roof. Whilst it is agreed that a ceiling and a roof are necessary and also that skylights are not good practice in a hospital because of the confusion of shadows, it is suggested that if the light of the sky were admitted in an oblique manner from the left, there would be no resulting confusion, and direct light from the sky would be permitted to reach to the wall farthest away from the windows. The windows now used to light the operating theatre of a hospital are designed to admit the maximum

amount of daylight practicable to the room. It is true that these windows face north to obtain a very clear, diffused light.

It is assumed that a hospital will always be lighted by electricity. The wiring should be laid out in conformity with the rules of the Institution of Electrical Engineers, and should generally be wiring in screwed conduits, the tubes and fittings being electrically and mechanically continuous and carefully earthed.

All rising mains should be concealed in ducts, with supports at intervals of 2′. The rising mains should be connected to a fuse-board on each floor, which is provided with a double-pole fuse-way serving groups of rooms on that floor served by the particular rising main.

Lighting needs in the public and general work spaces in hospitals differ little from those in other types of building. Intensity should be sufficient to ensure easy work and glare should be reduced to a minimum. In general, 5 to 10 foot-candles are sufficient in all public and general spaces, 15 to 20 foot-candles in offices where clerical work is interrupted and up to 40 foot-candles where reading and clerical work is relatively uninterrupted. Special requirements are necessary in wards, theatres, and the like, and have been reviewed in previous chapters.

Fluorescent lighting is rapidly replacing the use of filament bulbs, for the reasons that it is inherently more diffuse, has less glare, and the current consumption per candle-power is less than that of the filament type of lamp. Fluorescent fixtures have not generally reached the same level of decorative development as the older filament bulb type of fixtures, but due to the much less amount of heat developed it is quite certain that they will do so.

Any failure of the hospital lighting system carries a hazard of panic among patients. The best safeguard against this danger is a complete emergency lighting service. This consists of some alternative source of current such as an alternative connection to a public utility supply well separate from the usual service, an emergency engine-driven generator, or a set of storage batteries so equipped that they will be kept constantly under full charge. This secondary source of current is connected to an auxiliary circuit which in turn feeds exit lights and a sufficient number of corridor and other public space lights to give at least enough light to permit general circulation and allay the fear of patients in case of failure of the regular lighting system.

Plumbing. Piping in a hospital is apt to become very complicated, especially where active therapy and research are involved. In addition to hot, cold, chilled water and the several heating pipes, refrigeration pipes, etc., there are several gases to consider: illuminating gas, oxygen, compressed air, vacuum, and anaesthetising gases.

The grouping of the ward kitchens, bathrooms, etc., together, as well as the repetition of the same plan on all the floors, makes it possible to include all the main pipes going downwards and upwards in a duct specially provided for them and accessible on every floor. The services which run to and from the duct should be as short as possible, which also increases economy. At the bottom of the duct there must be an

accessible chamber, and the same duct is taken beyond the level of the roof for ventilation purposes. It is important that horizontal pipe ducts should be adequately ventilated by vertical flues at intervals or by some other means: this is not only to keep the air sweet and clean, but to prevent condensation on the underside of the floor above, as if this occurs it may saturate the concrete and cause trouble with the floor covering.

The internal service pipes and connections can be of copper or gunmetal with capillary joints. All can be neatly cut in chases in the walls, having flush movable covers for immediate access.

Heating. A hospital may be heated by means of either open fires or stoves, gas or electric fires, hot air, or steam or hot water.

The pros and cons of each will be fully discussed in Chapter 37.

Hot Water. Light-gauge copper is very suitable and, taking into consideration the simplicity of jointing light copper tubes, there is no great difference between the cost of copper and that of galvanised iron pipework. This does not apply to pipes of over 2″ dia., which in copper would require to be of medium or heavy gauge.

Copper piping is desirable when the water to be heated is soft, but there appears to be a tendency to install copper piping even where the quality of the water does not call for it, and with any material change in the relative prices of materials, this might result in unnecessary expenditure.

Domestic hot-water installations will be dealt with in Chapter 37.

Sanitary Fittings. Sanitary fittings, particularly sinks and lavatories, have been generally made of either enamelled cast-iron, fireclay, or vitreous china. For many years hospital designs have favoured the china product for its many superior qualities. The enamelled product is probably stronger, but it stains more readily, and when chipped is insanitary. Neither type is wholly satisfactory, particularly for the severe usage conditions that exist in hospitals. Already many sinks are being made of Monel metal or chromium-nickel steel. Such fittings are light in weight, they do not require heavy brackets for securing to the structure, and they do not craze, chip, or fracture. They are at least as easy to keep clean as the traditional types of fittings. It can safely be predicted that, in the future, fittings which possess these qualities will be in the greatest demand.

In hospitals there is a preference for fittings without backs. For ease of cleaning, fittings are usually supported on brackets about 2″ away from the wall. The wall at the back of the fittings is usually tiled in the interests of sanitation and ease of maintenance.

There are many types of tap controls. In surgical work or in any other situation where the sterile field of the arms must extend above the elbows, knee-action controls are preferred. Where only the hands need remain sterile, elbow action is sufficient. Elbow control generally involves two blades. As this is cumbersome, a single blade control with a mixing valve will soon become standard for elbow-activated installations. In order to avoid splashing, hospital sinks and basins are made about 8″ deep and the taps have a rose spray.

While it is desirable to reduce the number of special types of fittings to a minimum, hospital types are many and varied, depending on their special function. In tuberculosis work, for instance, it has been found desirable for patients to wash themselves in running water. For that reason, the wash-basin in such instances has no plug, but only a grating over the waste exit. Likewise, with tuberculosis patients it is customary to provide separate dental bowls in order to eliminate sputum from the wash-basin. Another example of special fittings to meet special conditions is a wash-basin for use by the chronic sick. Many of these patients are in wheel-chairs. This basin enables them to wash themselves while sitting in a wheel-chair (see Fig. 153).

Vacuum-cleaners. A central vacuum-cleaning plant has distinct advantages from the point of view of silence. A central plant is rather a luxury, but in hospitals it deserves serious consideration. A suction unit in the basement is connected by permanent pipelines into one or more outlets in each room, to which the usual hose and tools can be attached. When not in use, the outlets are closed by heavy metal caps. This method concentrates the machinery in one room, which can be adequately sound-proofed.

Individual vacuum-cleaners can be provided. Some of these cleaners clean purely by suction, and with these it is difficult to pick up cotton, etc. Other types incorporate revolving brushes or beaters, or both, and these are more effective.

Refuse Disposal. A dustbin service appeared in the past to work well enough where service lifts and porterage were available, depending to some extent on the frequency of collection. Where there is a balcony on which the dustbin can stand in the open air, the system is reasonably sanitary, though a daily service of emptying is essential and the bins should be washed daily. The dustbins must be of substantial construction and not of the flimsy commercial sheet-steel type. In the future, the disposal of refuse should be more adequately dealt with, and the dirty linen and kitchen balcony replaced. This can be done by placing a vertical chute at suitable points, discharging into a container at lower floor level, from which it is collected in a trolley (see Fig. 175).

The tendency will be to make use of some form of chute built into the structure. A good chute system should fulfil the following requirements:

a absence of smell at the hopper either when open, closed, or partially open (the last is the most difficult to achieve);
b size, position, and shape of the hopper designed to admit refuse without spilling;
c large enough to admit refuse without spilling and without choking;
d impervious and durable lining to the chute;
e adequate ventilation both in the form of air inlet and open top to the chute;
f collection at the foot without risk of spilling and soiling the surrounding structure or blowing about in windy weather;
g size to suit purpose for which it is to be used, i.e. kitchen refuse, dirty linen, mattresses, etc.

The usual materials are glazed stoneware, asbestos-cement, and galvanised sheet

iron for the chutes, and cast-iron and galvanised sheet for the hopper. Glazed stoneware is probably the best material, since it is impervious and hard wearing, but suffers from the disadvantage that the points where the hoppers enter have to be made good with cement rendering. In the case of asbestos-cement it is possible to obtain specially moulded units to take the cast-iron hoppers. Sheet-iron pipe should be galvanised after manufacture, but its life is problematical and it is noisy in use.

A damper or shutter is to be provided at the foot of the chute for use when the bin or container is removed. The shaft must be ventilated.

The question of washing-out chutes is very much the subject of opinion. The chutes certainly become foul with use, and in hospitals the chutes should be washed out by means of sparge pipes at the head of the chute discharging a sufficient volume of water to wash away any matter adhering to the walls. This must be done when the chute is not in use—that is, at night. The bin or container must be removed so that water can reach a gulley to be provided. Sink, operating theatre, and other particularly dirty chutes, should, when being washed out, be supplemented with cleaning by a sweep's brush.

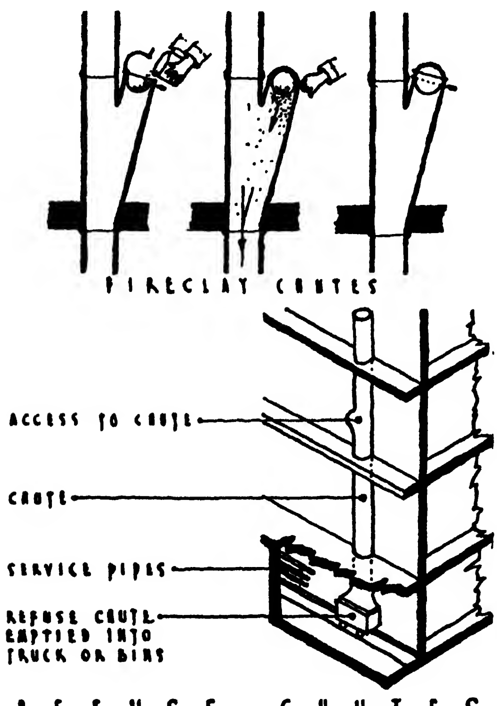


Fig. 175.

Methods of disposal from chutes: as far as Great Britain is concerned, either bins or wheeled containers placed under the foot of the chute form the usual method of collection. In America considerable progress has been made with methods of incineration on the site. The refuse falls direct into the incinerator and, when it has accumulated in sufficient quantity, is fired by a gas burner which is lit by pressing an electric button. As soon as the refuse is burning and reaches a certain temperature, a thermostat cuts off the gas supply. Destruction of refuse in the building itself is not necessarily so desirable as it appears at first sight, as there is still the ash to dispose of.

In recent years considerable progress has been made in methods of collection and transport of the refuse from buildings to the centralised disposal stations. The freighter-container system is best adapted for hospitals; it comprises a series of special bins or containers, a lorry to hold them, and pieces of apparatus to allow the container to be lifted on to the lorry; they are supplied by the local authority. The containers are designed to be placed under the outlet of refuse chutes and to stand in a chamber at ground level. The system is most easily operated where the chassis can draw up directly

alongside the container, and if a stand is provided which holds the containers at the level of the chassis, it allows the container to be pushed easily from the stand to the chassis. It will be obvious that the use of the container system depends on its adoption by the local authority and also arrangements made by the hospital authorities. The principal requirements are to make the collection of containers as easy as possible, and a route for the truck must be allowed for.

The refuse chute is a good means for the disposal of refuse, but the refuse as it drops under control into bins is only partly disposed of; the bins get full and have to be changed or collected at frequent intervals, and the chambers containing

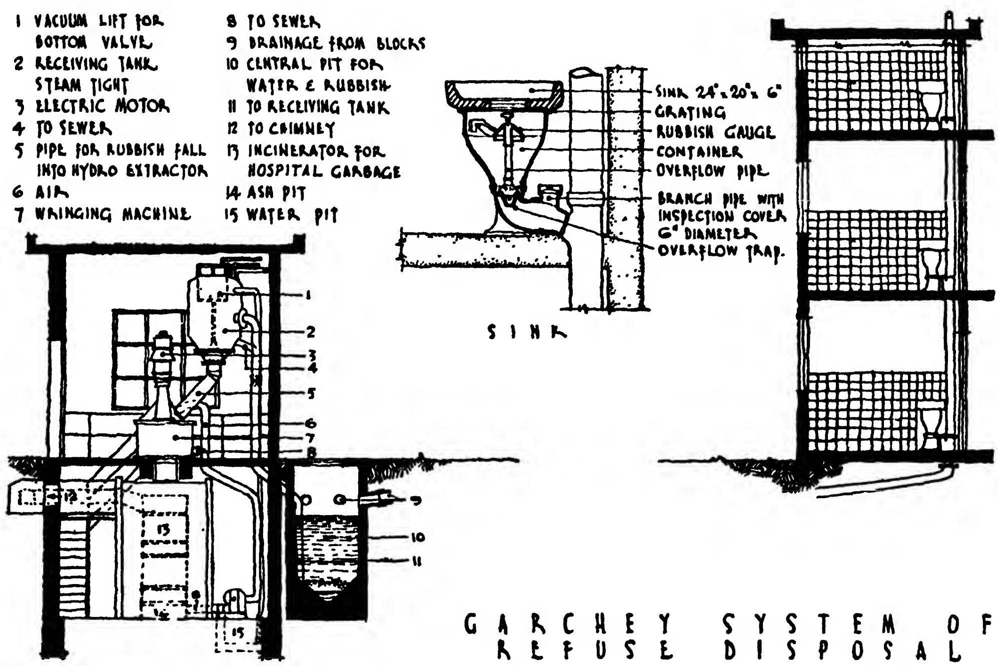


FIG. 176.

the bins need constant attention in order to avoid unpleasant and perhaps harmful gases. A system whereby refuse, liquid and solid, can be conveyed hygienically from each garbage sink direct to a refuse-disposal station commends itself for large schemes, a system which is simple to operate by the staff and inexpensive to install and maintain. The Garchey system (see Fig. 176) of refuse-disposal fulfils these requirements. It is of Canadian origin, but mostly used in France, and was introduced into Great Britain for the first time in a large municipal flat development at Leeds. All refuse and sink waste passes into a container via the sink, and, by the lifting of a plunger, is conveyed first by gravitation, in pipes, and then by suction to the disposal station, which is situated within the precincts of the hospital grounds. The unit consists of a glazed sink mounted on a cast-iron container, enamelled on the inside to facilitate cleaning. At the bottom of the

sink is a large outlet, through which the refuse drops by gravitation, and which can be closed by a metal plate. Water for flushing down the refuse is retained by means of a release plug at the bottom of the container, and so, by lifting the plug handle, the contents can be discharged through the trap. To prevent any chance of stoppages due to the refuse being too large to pass through the entire system, each container is fitted with a gauge which allows of the disposal of all normal household waste, such as ashes, tins, bottles, etc.

Refrigeration. At temperatures above 50 deg. F. good food deteriorates rapidly owing to the multiplication of bacteria, and refrigerators must therefore be provided for the storage of perishable food during a large portion of the year. It is important that the food should not be frozen, as in the thawing process food tissues deteriorate; and it is equally important that the air inside the cabinets or stores be dry, otherwise there may be trouble with fungoid growths.

Great progress has been made in refrigerator construction during the last 15 years. Most good makes are very quiet, and, being automatically operated by a thermostat, need little attention. In the future, if central refrigeration is provided in hospitals, it has the merit of replacing the compressors in the individual cabinets by a central machine which can be placed so as not to cause disturbance.

There is also the necessity of refrigerator plant for ice required for ice water, ice bags, oxygen tents, etc. The present mode is to use crushed ice. A recent study indicates, at least tentatively, that it is feasible to attach somewhat larger ice-making compartments to individual refrigerators, and have cubes produced in the right quantities and of the right size consistent with their use. The size of the ice cubes in this case would be somewhat smaller than is customary. Another possibility is the machine that makes "flake ice."

The formerly popular central refrigeration plant with distribution by the use of brine has largely given way to the modern individual electrically driven, air-cooled, self-contained unit. Such units are now obtainable in any desired size and of such design and temperature control as to fit them to any desired special use.

Even for the large kitchen refrigerators it is an accepted practice to use a battery of unit compressors and direct expansion coils rather than the former heavy-duty ammonia compressor and brine circulation. One reason for this is that it saves space and very much simplifies maintenance problems, as the compressed gas pipe and coils are much less subject to trouble than are brine pipes and coils. Another feature is the simplification of the provision for break-down service. Thus with a brine system for a 5-ton load there would be required two 5-ton compressors to ensure against interruption of service. For the same load, six or seven 1-ton compressors of the self-contained direct-expansion type would ensure adequate break-down service. Likewise this type of refrigeration is now in such common use that repair service and parts are much more promptly available than they are for the heavy-duty types of equipment.

Ice cubes have largely replaced the former cake ice tanks, and for ice-bag and

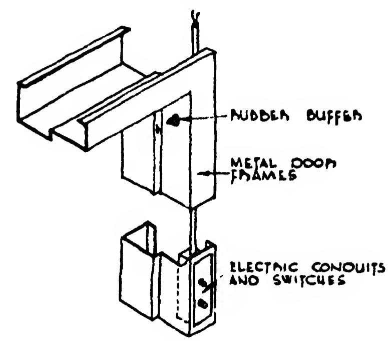
beverage service the new instant-freezing flake-ice machines are gaining in popularity. The cracked ice for use in ice-bags and collars is in some hospitals being replaced by filling the bags with a low-freezing-point mixture such as 10 per cent. glycerine or alcohol in water and freezing the mixture in the bag, thereby saving all the waste, labour, and general nuisance of the use of cracked ice. When this method is used it entails the provision of low-temperature freezing units—usually of lower temperature and in greater number than are found in the usual domestic refrigerator.

Doors. Door frames can be either of wood or steel, the latter with specially designed profile (in order to give a minimum opportunity for lodgement of dust, bacteria, etc.), including six legs for fixing and the threshold buried in screed (see Fig. 177).

Doors of hospitals are normally flush type, faced on both sides, stained and wax polished, with the names of the rooms indicated on the doors with synthetic letters. All finishes should be smooth and rounded, whenever possible, to avoid retention of dirt and dust.

The cupboard doors should also be flush finish, and are normally constructed of deal framing covered with ply facing to give a flush face for painting.

All the locks must be under a master key, a system somewhat similar to that used in hotels. The makers should keep a record, and thereby could supply a duplicate of any key on demand, so that it would not be necessary to send either a key or lock to the works.



METAL DOOR FRAME

FIG. 177.

Floor springs are provided at entrance to wards, etc., and can be of both metal and wood. They are of the type to suit shallow floors and are sealed against entry of water. If the door is pushed to the fully open position, it remains open, a slight pressure releasing it. This avoids the necessity for hooks and other devices to hold it open. The spring tension, closing speed, and hang of the door can be adjusted. All doors to ward units will be fitted with some self-closing device.

The usual bar-type panic bolts to means of escape doors can be superseded by a simple knob marked "Push" which, on a slight pressure, opens both doors. The flush bolts should be a type that lock in position and are released by pressing a small knob; this supersedes the lever type, which may be left projecting.

Minor Electrical Apparatus. By making possible storage within a minimum of space and enabling hospital duties to be performed with the minimum of disorganisation, the use of modern electrical fittings and equipment can do much to reduce the actual accommodation required.

An electric cooker can be provided in ward kitchens. It is normally rated to cook for

six to eight persons and is used for special diets. The type supplied may be either the vertical or horizontal type, the horizontal type takes up more wall space, but as both the oven and boiling plates are at table height, they are much more accessible than the other type.

Also there are electric kettles and other table cookery, such as toasters, warming-plates, water jugs, coffee percolators, etc. These small electrically heated appliances are useful at certain times, and are a convenience for which plug-point provision should be made in special units.

Electric irons—perhaps the best-known domestic appliance—should be provided in the nurses' home, etc.

Floor-polishing machines are useful for hardwood floors and linoleum. Some vacuum cleaners of the brush type can be fitted with floor polishing equipment.

Sewing machines are often fitted with a small electric motor and a shaded light to facilitate needle threading.

Telephones. The installation should consist of a private branch from the G.P.O. exchange, with extension lines to all principal departments and units. Coin-operated public telephones are required near public waiting-rooms.

These are supplemented by an internal house system between the principal executive officers and their staffs and ward sisters' offices, and a system of call signal lights.

As a guide, usually fifty G.P.O. lines and sixty internal house lines are provided for a five-hundred-bed hospital.

There is also available on the market a system of light signals which, on receipt of a call during the daytime, flashes the lamps in the room and during the evening dims the lights. The manufacturers have arranged that the G.P.O. will connect it to the telephone system.

Call System. Salaries constitute more than half of a hospital's expenditure. The installation of the various types of communication systems available should therefore be considered in terms of the paid-for labour they will save rather than under the broad term of convenience, a word which is likely to be appraised in terms of making things easier rather than in terms of the labour that will be saved.

The potential demand for electrical communication systems should be carefully explored before construction is started and provision for the conduct systems incorporated into the construction plans. This should provide not only for immediate apparent needs, but for all foreseeable needs for outlets. In deciding on the installation of any type of communication system these must always be considered:

- *a* cost of installation
- *b* cost of operation
- *c* volume of work
- *d* accuracy
- *e* labour saving.

Three principal means of communication commonly used in hospitals:

a staff call systems
b telephones
c paging systems.

In addition to these there is one other used particularly in the larger hospitals but applicable to a limited extent to hospitals down to the two-hundred-bed size. This is the pneumatic tube system which is actually a transportation system, but serves as a communication system for written memoranda and the like.

Staff call systems have been reviewed in Chapter 18 and telephones in the previous paragraph.

Paging systems are for use in locating personnel whose duties require them to circulate freely through many different parts of the hospital—primarily members of the medical staff, resident and visiting doctors; but it is often felt advisable to include the administrator, some of his assistants, and heads of departments such as matron, some supervisors, the house-keeper, and even the engineer. The visual system consists of lighted number panels placed at points most likely to be under continuous observation, connected to a keyboard—usually at the telephone switchboard. When the numbered key is pushed the number is flashed on all switchboards and remains until the operator cancels it. The operating mechanism may be arranged for the number to be continuously lighted or of the flashing type, alternating on and off until cancelled by the operator. The principal advantages of this system are:

a it is silent and hence not disturbing;
b several call numbers may be registered simultaneously and remain until the operator desires to cancel them;
c they are positive, eliminating any misunderstanding as to names;
d they lend themselves to other coded calls, such as "emergency call"; "ambulance call," "firecall," etc.

The disadvantage of visual call systems is that they depend upon the use of code numbers, and persons other than the one called may not recognise a call for a person other than himself and thus not pass the call along to the person for whom it is intended.

Wireless. Wireless reception may be provided by portable sets, but it is usual to have mains-operated radio sets supplied with permanent wiring, and plugs may, with advantage, be installed for supplying loudspeakers.

The wireless unit will distribute the ordinary broadcasting programmes, and a microphone is included so that one person can, if necessary, speak to all the patients in the hospital at the same time.

Clocks. The frequency of the grid supply is now controlled with such accuracy that all main rooms should be provided with electric clocks. The number required will vary

according to the size of the hospital, but will approximately correspond with the number of internal telephones. Clocks of 9″ diameter are suitable for most uses.

An interruption of the electricity mains supply does not stop the clock system. An automatic change-over switch brings an accumulator supply into service instantaneously. The accumulators are kept charged by a trickle charger and are capable of running the clocks for several days.

They should be provided on the system which is in the nature of an amplification of the common synchronous electric clock. The master clock is itself of the synchronous type, driven by a time-controlled A.C. main, and therefore always gives the correct time. The subsidiary dials, operated from the master clock, are therefore equally reliable.

Finishings. Too much care cannot be given to the selection of all finishings to walls, floors, and furniture, etc. They should be selected for taste, and capable of being easily cleaned.

The internal surface of buildings should be executed in suitable inexpensive materials that will effectively withstand the necessary wear. Various departments of a hospital require different treatment, e.g. although successful surgical operations may be performed under improvised conditions, it is reasonable and advisable that operating theatres and labour rooms should have walls, floors, and ceilings of special materials which can be easily cleaned. Ceilings of such rooms should also be made to resist condensation.

When two or more materials or methods of finishing are involved on the same wall surface, the extent of each and the nature and position of the dividing-line between them are questions that allow considerable discretionary latitude. The aesthetic effect, especially in wards, such as choice of colour, nature of surface, etc., also requires special consideration. It can be assumed as almost axiomatic that smooth, impervious, and unbroken surfaces, with rounded angles and avoidance of unnecessary ledges, should be adopted. In the sanitary units, the provision of surfaces that can be easily cleaned, especially in the neighbourhood of sanitary fittings, is particularly important.

Having given consideration to broad principles, it is therefore necessary to apply them to the hospital, unit by unit, and to make some attempt to estimate for each unit to what extent durability should be purchased at increased prime cost, where durability should take precedence over smoothness, how far aesthetic effect is to be considered in reference to these factors—for important though this effect may be, it cannot, except to a limited extent, take precedence over cost, nor must it take precedence over appropriateness in use.

Consideration must therefore be given to the use to which each part of the building will be put. Finishings for use in each department have been referred to in their respective chapters.

Colours. Whenever possible, functions should be served in the use of colour to decorate a hospital. While aesthetic factors are important, there is still greater need for a careful

attention to the emotional and physical comfort of the patient, so that colour will prove a definite aid to convalescence. Hospital problems are too specialised and too vital to be answered by mere styles or decorative vogues. Permanent values should be sought and a palette developed that will serve medicine and please the patient.

It is considered that an exciting effect, a subduing effect, and a rather neutral result may be expected with warm colours, cool colours, and yellowish-green colours respectively.

Personal preferences or prejudices aside, pale yellowish and pale greenish colours have an all-round utility. Warm tones—buffs, pinks, and salmons—appropriately belong in rooms and wards in which the patients are definitely on the road to recovery. These warm hues will bolster the spirit and encourage a desire to get well. Conversely, cool tones—blues, lavenders, and greys—appropriately belong in rooms occupied by chronic disease patients. They are far more restful and relaxing, and help to reconcile the mind of the individual to a more prolonged stay.

In the general colour treatment of a hospital a variety of fairly strong hues should be placed in the entrance hall and rooms for the visitors' accommodation. Variety in particular (though it must be carefully harmonised) will give the building a cheerful atmosphere. White and smaller areas of red and blue are safe colours to employ. They are universally liked and have a spontaneous charm. To judge from the reaction of most people to any environment that has the stamp of the institutional, severity is a pose that the hospital will do well to avoid.

In the accommodation for patients and in surgical and service departments functionalism should hold sway over aesthetics. Hospital corridors should be finished in light colours for high light reflection. Walls at the ends of corridors should show touches of colour for relief. Floors may be dark, although the skirtings should be lighter in tone (more like the walls), to reveal all traces of dirt or litter and to discourage those who may look for a place to discard something.

Hospital rooms should have tinted ceilings, either to match the wall or to contrast with it; if the ceilings are high the tone can be deeper than the walls. A room treated in this fashion will tend to rest the patient when he lies in bed and looks up at the dark tone, and he will be agreeably stimulated when he sits up or glances at the brighter walls.

Mottled paint finishes and unconventional wall covering patterns will relieve monotony. They are desirable, but not essential. Formal and geometric patterns of any sort should never appear in large areas. They distract the eye and mind and may lead to nervous irritability.

Generally, the most satisfying illumination is yellowish or golden (like the atmospheric tinge of sunset or Indian summer). Delicate orange-pink and magenta also are pleasant. Yellow-greens, greens, and blues are usually distressing. Of the cool hues, a soft bluish violet seems to be the only acceptable one.

If monotony is one of the curses of hospital occupancy, these observations may be turned to practical purposes. For example, it is highly desirable to design rooms in

soft buffs or greys that can, under the influence of an adjustable artificial light source, be shifted in appearance towards the warm side or the cool side of the spectrum. A hospital interior can thus be given a wider emotional range. Patients with a dislike for warm hues, for instance, can be readily satisfied with a cool illumination. The mere ability to produce pleasant shifts in the atmospheric appearance of a room may prove delightful to the patient, and delight in a patient is a salubrious tonic.

ACOUSTICAL TREATMENT

Noise that is needless must be eliminated. There are only two ways in which this can be done—by inventing gadgets to lessen the noise or by prevention at its source. The latter is by far the better method, but it demands foresight and wise planning.

It is assumed that all hospitals in the future will be sited in their own grounds and, therefore, consideration of transmission of vibrations of the public roadway, or air-borne sounds (street noise entering directly through windows, etc.) will not be considered. Structure-borne sounds from inside (noise of lift machinery and other service sounds within the building) and air-borne sounds from inside (noises within the working space created by the occupants themselves) must be considered.

To obviate structure-borne sound within the building, the superstructure itself must be split up into structural units, e.g. unit containing the staircase, lifts, blocks of lavatories, vertical air-conditioning ducts, etc. By making isolation joints of cork between one section and the adjacent section, the transmission of sound through structure, or even service ducts and conduits, to the working space can be largely eliminated.

Acoustic ceiling treatment will prove of considerable assistance in reducing noise in large rooms. If the flooring can be of cork laid on screed of foamed slag, the insulating qualities of these materials will prevent transmission of sound to the rooms below.

It will be readily appreciated that the preventive steps briefly outlined above do not claim to be the ideal solutions. If money and time are no object, there is no doubt that each individual problem can be analysed and improved on.

Most complaints are of transmission of noise through floors and the problem of silencing vertical ducts through the building; the latter can be lined with insulating board, packed with slag wool, or sealed off at floor levels.

The sharp noise that may arise from equipment such as door catches can be exceptionally irritating to an ill person. Considerable care must be exercised in the selection of equipment to ensure that it will be quiet in operation, for example, electric-light switches should be of the silent "hospital" type in which the switch strikes against small rubber pads.

Given acoustical treatment of corridors and service rooms in the patients' areas it is debatable whether acoustical treatment in patients' rooms is needed or even desirable. In working areas such as offices, central kitchen, and laundry, acoustical treatment is of value in improving the efficiency of employees even though these areas are sufficiently remote from patient areas to have no disturbing effect on patients. Since sound

absorption carries with it the possibility of absorption of oils, grease, and dirt, the character of the material selected for any given area should be carefully considered with this thought in mind.

Walls. From the point of view of sound insulation, partitions are divided into two groups, namely, single partitions and complex partitions. Research has shown that as far as single walls are concerned their sound insulation is determined almost entirely by their weight, the actual material that is used in their construction being unimportant. Hollow tiles are for this reason less insulating than an equally thick solid wall, not more, as is often thought. If light, sound insulating walls are required they must be multiple, for example, stud partitions. It will be felt that there is nothing new in this type of partition, but the fact is that research by the National Physical Laboratory has shown that it can be made appreciably more insulating than if built in the traditional style: as, for example, by insulating the edges of the double partition with cork. Cork insulated partitions have proved very satisfactory in practice, but it may be that time will produce an insulating material which is better for this purpose than cork. Materials of the thermacoust type seem to be a step in the right direction.

Floors. The general tendency in sound insulating flooring appears to be towards laying an insulated floating floor over the structural floor, since by this means not only is the transmission to the structural floor of sound due to footsteps minimised, but also (a feature of considerable general importance) the transmission to the walls of the building, and hence to more distant rooms, is reduced. The latter is not obtainable from a suspended ceiling, which insulates the room below only. In fact, a suspended ceiling finds its chief use either when in conjunction with a floating floor to obtain a high degree of insulation, or when the level of the floor to be insulated must not be altered. Floating floors also have practical advantages in that service pipes can often be run below them.

Windows. If sound-proofing is to be carried out to windows, there is very little doubt that air-conditioning and double windows must be used. It is doubtful whether artificial ventilation will be adopted in wards, as there is no question that nurses would insist on opening the windows, thus upsetting the balance of the air circulation through the plant.

Doors. For sound-insulating doors there are three types of construction, namely, single solid doors, single composite doors, and pairs of doors. The relation between sound-insulation and weight per square foot—as for walls—holds in the case of doors. It appears that the production of a light, sound-proof door is very unlikely, but future developments will most likely be in the manufacture of cheap and easily fitted devices for rendering a door sound-tight.

Doors in constant use should be fitted with a controlling device to stop slamming.

Examples are pneumatic checks, check action hinges, or check action floor springs. If devices of this kind are deemed too expensive, rubber, leather, or felt buffers may be used, though they are probably not as effective.

Services. The almost universal nuisance of noise caused by water services can be practically avoided if silent equipment is selected, and if the plumbing is intelligently and carefully carried out. If, however, for some reason noise should be generated in a water system, it can travel along metal pipes almost unhindered and cause disturbance in all parts of the building. A few elementary precautions are—not fixing to or in any thin partition which might, by acting as a sounding board, greatly amplify the noise. Insulated clips (with rubber or other soft packing) should be used, and any caulking of holes made for the passage of such pipes through walls or floors should be done with resilient material. Cisterns and radiators should also be insulated by resilient mountings from floor or walls to which they are attached.

Service ducts are advocated for enclosing noisy piping. Such ducts should be as massive in construction as possible, preferably equivalent to 9″ brickwork, to prevent conduction of noise by the ducts themselves about the building. The interior surfaces of the duct should be as sound-absorbing as possible, i.e. they might be of unplastered clinker or, better still, pumice concrete.

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Engineering Services

LIKE INTERNAL human organs the engineering services of a building are not visible from the outside, yet they are all-important to proper functioning. It is not possible, nor is it intended, to give here a complete, detailed statement of principles involved in planning these services. Rather, it is hoped to bring out those phases and tendencies which are applicable to progress in hospital design. The order of discussion of the items is not an indication of their importance, merely that of convenience.

In addition to the purely structural and special finish requirements, the mechanical and electrical features are probably the most complicated that the architect and engineer is called upon to provide. And since service must be uninterrupted, day or night, holiday or work day, every provision must be made to prevent breakdown or to provide alternative service.

In Chapter 2, it has already been emphasised that the architect should be appointed before the site is purchased, to advise on the design and layout; also the consulting engineer should be appointed at an early stage in the preliminary work so as to collaborate closely with the architect. The consulting engineer should be responsible for the general design and layout of the various engineering services.

The engineering services of a modern hospital comprise several independent installations, both mechanical and electrical, their number and capacity being governed by the type and size of the hospital—whether general, infectious, sanatorium, children's, mental, etc. They will include water supply, drainage and sewage disposal, heating and lighting, the provision of hot water and gas, the installation of kitchen, laundry, and other equipment, and possibly the generation of electric power.

DRAINAGE AND SEWAGE DISPOSAL

The foul and surface water drainage of a hospital should, wherever possible, be connected to public sewers. If access to a public sewer cannot be obtained, sufficient land for sewage disposal should be purchased to enable the foul drainage to be dealt with on the site and as far from the buildings as may be necessary to avoid nuisance.

Where a sewage disposal scheme is provided, separate schemes for foul water and surface water should be provided, and the treatment of the former should conform to the usual standards required by the Ministry of Health, and where sufficient land of a suitable nature is available, broad irrigation should be adopted.

Experience has proved that the drains and plumbing in hospitals are subject to very

severe tests; that is why, in spite of the higher costs, all drains in subways and other exposed positions should be in cast-iron, including the chambers. All the drains, as far as possible, should be included in the subway, and are thereby accessible for control purposes.

Rain-water from the roofs may be conveyed by a separate system of drains to an underground tank or tanks for use in the laundry and, possibly, the boilers.

WATER SUPPLY

Wherever possible water should be obtained from a public supply. If no public supply is available, a well or bore-holes of sufficient size to enable duplicate pumping plant to be installed will be required.

The quantity of water required is usually estimated at from 40 to 50 galls. per head (patients and staff) per day in mental hospitals to 80 to 90 galls. in acute general and fever hospitals, and this amount should not be exceeded. With a view to tracing excessive use or wastage, meters can be inserted in each of the different blocks to measure the water used; this is essential if the sewage is treated at disposal works.

Whether the water is obtained on the site or from the public mains, it is usually delivered to a storage tank situated at such a level as to command the whole of the building site and give adequate pressure to all points of draw-off, normally 30′ higher than the highest point to be served. The capacity of the storage tank should not normally exceed two days' demand, and might be considerably less if the supply is derived from a trunk main in the road, in which case a long period of interruption is unlikely. The minimum storage in the high service cold-water tank should be 15,000 galls. for a five-hundred-bed hospital.

When the water contains more than 10 per cent. hardness, that required for use in the laundry and for domestic hot water should be softened. The prevention of incrustation of domestic hot-water services, and the softening of water for the laundry and boiler feed purposes, are the primary objects of installing a water-softening plant. Wherever possible the water treated should only be used for the before-mentioned purposes, as it is a waste of money to use softened water for cold-water services, flushing cisterns, etc. Rain-water can be collected for boiler-feed purposes.

When hard water comes in contact with soap, no soap action results until the hardness is neutralised by the soap or other chemical in the soap mixture. This neutralising action consumes approximately 0·07 lb. of soap per 100 galls. per degree of hardness. This action of hardness on soap gives rise to the so-called soap curds commonly seen as specks on linen and in the dirt rim on the bath or lavatory basin. These soap curds deposit in the linen, imparting to it a greyish colour, an "off" odour, and harshness to the touch.

Another effect of hard water is the deposit of the hard salts on the interior surface of boilers and hot-water pipes. On iron pipe this deposit may be so great as to markedly reduce the capacity or even to practically corrode the pipe. Since this scale does not adhere to copper the use of copper pipe for all hot-water pipes will obviate the difficulty.

In the hospital, return pipes from sterilisers are particularly subject to corrosion and they should be of copper rather than the conventional iron pipe.

There is a wide variation in the degree of hardness in water from different sources. Thus the hardness of water from deep wells is constant and may be very high, or that from large open sources such as large lakes is usually relative, depending upon weather conditions in the watershed.

The method of water softening most favoured by hospitals is the so-called zeolite process. In this process the zeolite exchanges its sodium for the "hard" lime and magnesium as the water passes through the zeolite bed. When its sodium is exhausted it is regenerated by flushing with saltbrine, the brine giving up its sodium to the zeolite in exchange for the "hard" salts it has accumulated, the hard salts being flushed out to the drains during the process of "regeneration." Experience indicates that the softening of water for the hot-water services results in sufficient savings in soap to pay for the cost of installation and operation in not more than two years; in some instances, in the first year. This is in addition to avoiding the scale in hot-water pipes, the destructive action of fragments of scale on valves, and the difficulties in boiler maintenance which result from hardness in the feed water.

FIRE PRECAUTIONS

A separate fire main with sufficient water pressure need not be provided unless considered essential by the local fire brigade authority, but fire extinguishers and adequate fire-fighting apparatus should be readily available to enable the staff to deal with any outbreak of fire pending the arrival of the local fire brigade. In a large scheme a ring main will normally be provided, with hydrants and hose reels at suitable positions (both inside and outside the building), and alarm indicators fixed in prominent positions.

If an efficient local fire brigade is readily available, a combined fire and cold water main with internal and external hydrants should meet the requirements; but in rural areas storage for not less than 50,000 to 60,000 galls. should be provided.

If a high resistance to fire does become a post-war requirement, its effect upon structural technique is likely to occur along some of the following lines:

- *a* the elimination (at least for structural purposes) of all combustible materials or materials below some degree of combustibility;
- *b* the inclusion of special "fire-stops," formed either by special fire-resistant materials or by breaking the continuity of structures;
- *c* the inclusion of special structural facilities for fire fighters, such as access ways to roofs, etc.;
- *d* the provision of specially resistant roof and wall surfaces to prevent rapid ignition from outside sources: such or similar requirements would certainly have a considerable effect upon the structural use of materials, and might well involve important developments in the production of special fire-resistant materials and in methods of reducing the combustibility of others.

VENTILATION

There are several means of obtaining what is known as "natural ventilation," one, of course, being the open-window method, which, even with the modern design of hospital windows, remains completely out of control and is entirely dependent upon the direction of the prevailing winds. In most cases, however, an open window will ensure a reasonable rate of ventilation, though rarely without draughts.

Natural ventilation will rarely be relied upon in future hospital buildings in town areas, and in special departments never, as a balanced system will be provided by mechanical ventilation. Fresh air is drawn from above roof level through a shaft to an air-conditioning plant in the basement, the air passing successively through tempering coils, in viscous self-cleaning filter, air washer, and heating battery, whence it is delivered by an electrically driven centrifugal fan, filtered and tempered in respect of temperature and humidity, to ducts connected to another electrically driven centrifugal fan, which draws vitiated air from these rooms and discharges it through another shaft. Inter-connection between the main fresh and extract air ducts, with damper control, permits recirculation when desirable.

No mechanical ventilation plant should be installed unless it is provided with some means of filtering air. This is accomplished in the latest forms of air filters by passing the air between corrugated plates, through sheets of expanded metals or masses of spiral springs, or rings coated with oil, or, alternatively, through specially prepared textile fabrics. With such types of air filter it is possible to remove between 80 and 90 per cent. of the solid impurities contained in the incoming air, but no control of humidity is possible.

A scientifically designed ventilation and air-conditioning plant will have the air filter replaced by an air-washer, consisting of a chamber through which the air is passed and cleansed by a finely atomised water spray, finally passing through corrugated plates to remove entrained moisture before entering the duct system. Apart from the possibility of controlling moisture evaporation by the use of the air washer, up to 98 per cent. of the dust is removed and an appreciable cooling effect is obtained. One of the objections to air conditioning is the fear of air-borne bacteria incident to the assumed necessity of recirculating air. The more modern methods of air conditioning do not involve recirculation, thus eliminating return ducts, and supply ducts are mere tubes no thicker than a correspondingly insulated steam pipe.

In choosing small ventilation items such as desk fans, circulating and extractor fans, it should be remembered that silence in operation is at least as important as any other feature. Points to be looked for are: slow running speeds, plain rather than ball bearings, and rigid construction.

With regard to means of ventilation for the operating and radio-diagnostic suites and the central kitchen, in these rooms natural ventilation should always be supplemented by electric exhaust fans, but where the operating theatre is in frequent use a small air-conditioning plant should be installed.

Temperature and Air Changes. The amount of fresh air entering the room, to be allowed for while the given temperature is to be maintained, is generally expressed as the number of complete air changes per hour.

In the design of any system of heating, the engineer has to provide heat for raising and maintaining the temperature of the air inside the building above that of the outside, and must allow for loss of heat by ventilation and by transmission through walls, windows, floors, and roofs. There is considerable diversity of practice as to the temperatures which are specified as necessary to give the desired conditions of comfort in the various sections of the building and as to the allowance to be made for loss of heat by ventilation, which is dependent upon the number of air changes per hour.

The following table taken from The Report illustrates the difference of opinion among consulting engineers and medical administrators as to temperatures at which the various rooms should be maintained in hospitals generally:

		deg. F.
a	wards	60 to 65
b	corridors	40 to 60
c	dormitories	45 to 65
d	day-rooms and dining	60 to 65
e	nurses' bedrooms	50 to 60
f	operating theatres	65 to 80

No doubt some of these variations are due to the different types of hospital. For instance, a higher temperature would be required in buildings occupied by sick persons than in those occupied by physically healthy mental patients. Not only is there lack of agreement as to the desirable atmosphere environment for different states of health and sickness, but the difficulty of representing, by means of an air temperature, all the factors involved in maintaining suitable conditions has not yet been overcome.

With regard to air changes, the difference of opinion found by The Report is shown by the following table:

a	wards	1½ to 5 changes per hour
b	dormitories	1½ to 5 changes per hour
c	corridors	1½ to 5 changes per hour
d	day-rooms and dining	2 to 5 changes per hour
e	nurses' bedrooms	1 to 3 changes per hour
f	operating theatres	4 to 20 changes per hour

The rate of air change cannot readily be tested and the adoption of a particular rate does not appear to rest on any reliable experimental data. The figure assumed for the rate of air change is, however, an important factor in the calculation of heat loss.

Where ordinary convection apparatus (pipes and radiators) is the heating medium, The Report suggests the adoption of the following air change factors:

a	wards	3 changes per hour
b	dormitories	
c	day-rooms and dining	
d	corridors	2 changes per hour
e	nurses' bedrooms	
f	operating theatres	10 changes per hour

These factors are merely a basis for engineering calculations and do not represent actual air changes recommended. Where heat is emitted by radiation through ceiling or wall·panels it is claimed that the above figures can be reduced, as, with such a small amount of air calculation, it is sufficient to maintain conditions of comfort and avoid any feeling of stuffiness. While such a reduction might be made in the case of day-rooms, dining-rooms, corridors, and nurses' bedrooms, The Report does not recommend that in the wards or in operating theatres any reduction should be made in the air change factor to be used in the calculation of heating power.

HEATING SYSTEMS

On rare occasions, when nature permits, a glimpse of what perfect warming, air-conditioning, and lighting really is may be experienced. No warming system conceived by man has ever yet reproduced the conditions of a fine day in mid-ocean or the refreshing breezes and dustless air of a sunlit day in the Swiss Alps. These are ideals set by nature for the guidance of man. The scientist strives to analyse, the expert struggles to attain, but the majority of us periodically blow our noses and adjust our spectacles and live in hope.

In modern heating practice, the engineer aims at comfortable warmth rather than high temperature, for experience has shown that the nature of the heat, rather than the amount, is the most important factor affecting comfort.

Choice of Fuel. Before the form of heating is selected the choice of fuel must be decided. This is generally governed by consideration of economics, cleanliness, convenience, and labour.

The choice of fuel and the provision of best means for its combustion are the major elements in determining the cost of operation of the power plant. The fuels normally available are gas, oil, coke, and coal. The choice of fuel is largely a matter of geography, as the transport of the fuel from its point of consumption usually represents at least half of its final cost. This question of relative availability of fuels is noted because maximum economy of any fuel depends in great measure as how well the combustion apparatus is suited to the fuel. The combustion apparatus for the boilers should therefore be selected with a view to the use of that fuel which is likely to be most economical in use.

Oil, being ashless, is an ideal fuel for the firing of boilers; being a fluid, it is more easily handled than coal or coke and can be stored in positions impossible with other fuels. Oil is, moreover, relatively more dense, and, having a higher calorific value per unit of weight, does not need to be stored in such large quantities. Dr. Oscar Faber has prepared the following table, which shows the comparative space occupied by 1 ton of oil, coal, and coke, together with the potential heat value in each case.

FUEL	LB. PER CU. FT.	CU. FT. PER TON	CALORIFIC VALUE IN B.T.U. PER LB. NET.	POTENTIAL HEAT VALUE IN B.T.U. PER CU. FT. OF FUEL
Oil	56	40	18,000	1,000,000
Anthracite	50	45	14,000	700,000
Coal (average)	45	50	13,500	610,000
Coke	25	90	12,500	310,000

Further advantages of oil fuel are cleanliness, convenience, and flexibility of operation and saving of labour generally. The first has a money value which is difficult to assess. Its disadvantage is cost, which is higher than with coal or coke, though many cases exist where this is balanced by a corresponding saving in labour. Similarly, its great facility for automatic control often brings about greater economy of heat than is possible with a hand-fired, hand-controlled system.

Thus each case requires to be considered on its merits and no generalisation can really do justice to the case for oil. During the war difficulty was incurred in obtaining sufficient oil to feed the oil-fed boilers already installed, but in the future it is to be assumed that oil produced from coal by the hydrogeneration process will be available. Owing to the fact that such oils are obtained from wells in various parts of the world they vary considerably in their physical and chemical characteristics, but the oil companies, by a process of blending, offer fuel suitable for oil fed boilers.

Forms of Heating. The number of different heating systems is almost unlimited if every combination of fuel, method of firing, transmission medium, type of radiating or convecting element is considered. The major heat loss of buildings is through and around openings such as doors and windows, with a much smaller leakage through walls and roof. It is thus evident that the care with which the building is built to avoid loss may have a marked effect on the heating capacity it is necessary to install.

Open fires were, of course, the primitive source of heat, but these, with anthracite and coke stoves, entail carrying fuel about the hospital and involve more labour. Also there are oil stoves which discharge objectionable fumes in the rooms. Gas fires and radiators have been greatly improved in recent years, with special forms of radiant elements. All direct electric heating is 100 per cent. efficient. In hospital design, all

these types of heating are used mainly in supplementing other forms of heating or to give temporary comfort in isolated rooms. All the foregoing are known as "direct" systems of heating, whereas in hospital design "indirect" systems, with a liquid medium employed in the form of water, owing to its cheapness and high specific heat, are employed. Hot-water systems have the great advantage over vapour systems (including high- and low-pressure steam) of being in practice readily capable of regulation to meet outside temperature changes, of being readily simple, safe, and silent, and of providing a surface at a moderate temperature which neither burns nor produces stuffiness by roasting the dust particles. They have, however (continuing the comparison), the disadvantages of greater time lag, a greater surface of radiator required, and greater cost; nevertheless, their greater cost is well justified in hospital buildings by their advantages.

Exposed pipes are the cheapest form of heating surface, of which the early greenhouse system is a well-known forerunner. Radiators are too well known to require any description. A remarkable thing about the radiator is that it only radiates about 20 per cent. of its heat and convects the rest. Flat panels may either be of cast iron with waterways in protuberances cast on behind, or of wrought sheets with tubes brazed or welded thereto. They may either be built into the wall or ceiling, with insulating material behind them, and in this position give about 60 per cent. radiation in walls and 90 per cent. radiation on ceilings, or they may have ribs on the back and stand clear of the wall, with an intervening air current, in which case they are intermediate in function between the ordinary radiator and true flat panels, and in this case the heat by radiation falls from about 60 to 30 per cent., the convected heat, of course, gaining correspondingly.

There are in Great Britain very few steam heating systems, whereas in America and Canada the reverse is the case. The reason is not difficult to find, our weather in winter often being mild, whereas their winters are generally severe. Steam is unsuitable for use in the embedded panel systems, and whilst it has been used in the metallic plate and Ray-rad type, the surface is much too hot for comfort. Ordinary radiators and convectors are the most suitable heating surface; the former need guards for protection against burning where patients are likely to touch them.

The advantage of steam as a medium of heating as compared with hot water is best shown in the case of an infectious diseases hospital, as the system is not subject to damage by frost when the building is disused for a long period.

Hot air is another medium which combines heating with ventilation, but in connection with hospitals it is now seldom adopted except for operating theatres, where the removal of ether fumes without loss of temperature constitutes the principal reason for its installation. The system is somewhat expensive to install and maintain, and the difficulty in keeping the air ducts regularly cleansed renders its use undesirable in a hospital, except in an operating theatre where the ducts can be short and accessible.

The Report considered the evidence of many witnesses and found that the consensus of opinion was that low-pressure water was the best medium to adopt, but that such a

system could not be recommended for universal application, and the decision as to which form of heating should be installed could only be arrived at after consideration of all the circumstances.

There may be special circumstances which make the centralisation of the heating and hot-water services either excessively costly or impracticable. In estimating the two alternative systems (centralisation versus independent boilers) it is necessary to include the cost of ducts in which the pipes from the central power house would be laid. Where these would traverse ground unsuitable owing to levels or to the presence of running sand or water, heavy expense in construction would be involved, and this might be a deciding factor in favour of installing independent units in each block.

The Report states that it was generally agreed that, although the first cost of centralisation is definitely higher, the economy in operating is so marked that, having regard to both capital charges and operating expenses, it will almost invariably be found more economical to provide a central power house, at any rate in the case of a general hospital.

Radiators versus Panels. The use of panels for heating is a comparatively recent pre-war development and The Report stated that, until information about costs of operation and maintenance was available, radiators should be looked upon as standard practice. The Central Bureau of Hospital Information, working in conjunction with the Invisible Panel Warming Association, in 1938 conducted a thorough investigation and found:

- *a* from the users' point of view the system seems to be popular;
- *b* the absence of exposed pipes was a real advantage;
- *c* less cleaning was required, also cost of periodic redecoration was reduced;
- *d* while this report regrets the omission of costs it concludes, quite fairly, that tests on other buildings have shown substantial savings, and there appears to be no logical reason why in hospitals the same economy should not be secured.

As regards the use of control, it is admitted that the embedded panel has a long-time lag, i.e. the temperature cannot be raised or lowered quickly to conform to sudden variations in climatic conditions. In this respect, therefore, the embedded panel is inferior to both the applied panel and the radiator; but it has the advantage of being worked at a lower temperature, and in that respect is to be preferred on physiological grounds.

For the patient there is one very important argument of which too little has been heard. Air currents are a definite factor in the transmission of infectious diseases, and where convection currents are absent the risk of infection is much reduced. Flat panel heating, with its absence of convection currents, may reduce the transmission of infection, which is an important consideration.

The medical profession has for years drawn attention to the insanitary atmospheric conditions set up by the ordinary multi-column radiators, these being nothing more than

dust traps. The invisible radiant panel is the latest and so far the best heating medium in this respect. Panels, while being invisible, should not be hidden, and must be instantly responsive to valve control. Plain surfaced panels can be fitted in any position, wall, floor, or ceiling, and are practically unlimited as to the shape they take—flat, concave, convex, etc., and thus ensure that the rays travel to every part of a room.

When radiators are adopted for emitting the heat required, they should be of the ordinary hospital type, and painted. They should be supported on brackets fixed in the wall so as to offer no obstruction to the cleaning of the floor below them, and should not be hinged but should be far enough from the walls to give easy access for cleaning. Objections usually raised to the use of radiators are that they take up floor space, are difficult to keep clean, and restrict the layout of furniture.

Hot Air with Mechanical Ventilation. This system is confined to special cases, such as operating theatres, where a high temperature is required for only a few hours, and supplements the ordinary heating which is kept on continuously to maintain the walls and floors at a more normal temperature.

DOMESTIC HOT WATER

There should be two completely separate systems of pipe-work for hot-water supply and for central heating. Combined systems have been installed with a considerable saving in capital cost, but have proved to be unsatisfactory and uneconomical in operation. The domestic hot water (except where there is a laundry) must be kept at a fairly constant temperature of 130 deg. to 140 deg. F., while if proper economy is to be observed, the temperature of the water in the heating system should be raised or lowered to meet weather changes. These two requirements cannot be met in a combined system except by the provision and use of a complicated arrangement of hand-controlling mixing valves.

Hot-water supply systems may be local or central, exactly as in the case of heating systems. Local systems are those in which the water is heated immediately adjacent to the fitting where it is used. A central system is one in which water for the whole building, or group of buildings, is heated at one central point and is conducted to the various fittings through a system of pipes.

Advantages of the central system are:

a absence of a multiplicity of small heaters, each requiring periodical maintenance and occupying valuable space;

b greater reserve available at any single draw-off point, since the whole storage system may be drawn off at one time if need be: the local system is confined to its small storage at each point;

c cheap fuel may be used in the boiler, whereas local heaters require an expensive fuel, such as electricity or gas.

Advantages of local systems are:

a radiation from long runs of main is eliminated;

b one system of piping only is required, the cold-service pipes feeding each heater in turn; against this it must be remembered that additional gas piping or electric wiring is required;

c the overall working efficiency, i.e. the ratio: heat delivered to water at heater, may be higher with local systems than with central ones. There are a great many cases where local hot-water supply systems are applicable and where they may give greater economy of running; but in the main the central system generally has the balance of advantages in hospital schemes.

It is usual to provide a central system of calorifiers with a forced circulation for distribution, as regulation of the temperature of the water can be easily affected and a stand-by calorifier can be economically provided for emergencies, cleaning, etc.

It may be useful here to mention that the average temperature for hot baths is 100 deg. F. A normal bath contains about 30 galls. of water, so that if the hot supply is at 150 deg. F. and the cold-water supply at 50 deg. F., approximately half of each will be required, i.e. 15 galls. of hot water for each hot bath.

The following hot-water consumption table is interesting:

TYPE OF BUILDING	CONSUMPTION PER DAY PER OCCUPANT IN GALLS. (WATER AT 140 DEG. F.)	PEAK CONSUMPTION PER HOUR PER OCCUPANT IN GALLS.
Infectious	50	10
Acute	35	7
Mental	25	5

but the whole hot-water consumption varies from about 50 galls. to more than 150 galls. per day per patient, depending upon the economy with which it is used. The laundry requires from 30 to 50 galls., and the domestic supply the remainder, except for a relatively small amount for the central kitchen. Proper laundering and dish-washing requires water at a temperature of 175 deg. F., while as previously stated 140 deg. F. is adequate, and more economical for all other purposes. The two temperatures may be secured by heating to the highest temperature and reducing temperature by use of a tempering valve diluting the branch for the domestic circulation with cold water to bring it down to the desired 140 deg. F. Another method is to use two water boilers, one set for the higher and one for the lower temperature. This method has the advantage that in case of breakdown of one the other will still be available for service. In any case, it is vital that both the high and the low temperature hot water be supplied, even though it entails some duplication of the hot-water piping services. All hot-water piping should be of copper—as this type of piping has much greater resistance to the corrosion, erosion, and incrustation effects of the salts ordinarily found in water supplies.

In determining capacities to be installed it should be noted that all of the laundry hot water and about half of the domestic hot water is used between 7 a.m. and 4 p.m.

There is no recognised rule for calculating the amount of hot-water storage required, but 5 galls. storage per head (patients and staff) should be sufficient. The consumption of hot water varies very considerably in different departments of various classes, and in some departments (i.e. the nurses' home) the consumption is unnecessarily high. This leads to waste of fuel in providing the heat required, and therefore economy in capital and operating costs can be secured by the exercise of proper control and supervision in the use of hot water; this can be obtained by the installation of meters to record the consumption in each department.

STEAM AND CONDENSE SERVICES

In addition to the steam and condense services to the central kitchen and laundry, provision must also be made for these services to be taken to disinfectors, sterilisers, tracheotomy jets, and special departments where low-pressure steamheating is required.

High-pressure steam for the sterilisation of dressings is essential, and modern practice prefers the steam method for the sterilisation of instruments and utensils. The steam for autoclave operation may be taken from the steam pipes, a separate pipe from the boilers to the sterilising apparatus or the autoclaves may be equipped with individual sub-boilers heated by gas or electricity. In the hospital where there is no other reason for maintaining high-pressure steam night and day, gas or electricity heated sterilisers offer many advantages. They are ready at all times and entirely independent of any other source of steam: they are more expensive in installation and operation per hour, but their independence of any other source of supply more than compensates for their cost. As between the use of gas or electricity, the electrically operated is preferable if a dependable source of current is available.

Since the laundry and kitchen demands for high-pressure steam do not cover more than 40 to 50 hours per week, from morning to early afternoon and sterilisers must be ready for operation at all times, it is apparent that the use of steam from the main boilers for operation of the sterilisers requires the maintenance of high pressure for approximately two-thirds of the time when high pressure is not needed for any other purpose except, perhaps, for the production of electric power.

Sterilisers operate satisfactorily on a pressure of 40 lb. per sq. in., kitchen equipment at 15 lb. per sq. in., and water may be heated by steam at any pressure above zero and room heating seldom requires pressure above 5 to 8 lb. per sq. in. Low-pressure boilers (15 lb. per sq. in. or less) are less expensive in first cost, require more space for equivalent capacity, and are usually less economical in the use of fuel. But high-pressure boilers require the constant attendance of trained engineers 7 days a week for 24 hours a day. Low-pressure boilers do not require such expensive attendance and if oil or gas-fired may be arranged for a high degree of automatic control.

GENERATION OF ELECTRICITY

One of the major problems confronting an engineer when designing the engineering services of a hospital is whether he is to provide for generation of electricity in the central power-house. The purpose for which electricity is required may be divided into two parts, viz. lighting and power, the latter includes supplies for electro-medical purposes (i.e. radio-diagnostic and physio-therapy departments, etc.) together with supplies to laundry, central kitchen, stores, lifts, wards, and staff quarters. The use of electricity for heating should be restricted to the same class of rooms as for gas (see latter); it is more expensive and its use should be confined to cases where heating is only required for short periods and when the cost of electricity is comparatively low.

The problem is a complicated one and is not capable of a single solution to meet all cases. There are other factors than a mere comparison of the cost per unit from the alternative sources, which have to be taken into consideration; for instance, it is desirable that hospital engineering should be as simple to handle as possible. On the other hand, the liability to interruption of a public supply, owing to breakdown, must not be ignored. Each proposal for local generation should, therefore, be supported by a carefully reasoned estimate comparing its cost with that of a public supply, and this estimate should be prepared by an independent engineer experienced in that branch of engineering, while due weight should also be given to all the other factors. Even if it can be shown that there is no great difference in cost, a public supply should be taken, especially in view of the possible reduction in charges for public supplies.

Emergency lighting should be by electricity from a storage battery. The number of points served by such plant should be reduced to a minimum, but should enable the operating theatre to have its full load.

Lighting. It is assumed that a hospital will always be lighted by electricity owing to its convenience, ease of control, and cleanliness. The wiring should be laid out in conformity with the rules of the Institution of Electrical Engineers, and should generally be wiring in screwed conduits, the tubes and fittings being electrically and mechanically continuous and carefully earthed.

Artificial lighting should be carefully studied in relation to the comfort of the patients and staff. No artificial lighting system has yet been evolved to produce the perfect lighting conditions to be found in the shade of a tree at noonday on a sunny day in June.

The ideal solution to the problem would undoubtedly be a form of totally indirect lighting that could be concentrated in a few sources of great intensity. Unfortunately, there is no known technique for doing this successfully. The next best is a combination of totally indirect and totally direct sources, supplemented perhaps by separate lighting at special places.

The points to be considered in designing the lighting are: intensity, glare, distribution, and colour. There are many views on what is considered a suitable intensity for

various units, and certain recommendations are made in the Electric Light Manufacturers Association's Report as to the intensity of foot-candles. In considering the type and colour of lamps required, it is suggested that the incandescent filament lamps are inefficient and costly to maintain; lamps containing a combination of incandescent vapours may now be adjusted to produce an approximation of daylight about 90 per cent. correct—a disadvantage of these lamps is that they require current of a high voltage, stepped up to avoid the necessity of much length of heavy wiring. They do not, however, burn out as quickly as the filament lamps, and the colour can be adjusted to suit the particular use and room for which it is required.

The "mainly direct" type of fitting is now considered the most desirable design for hospitals, and this may take the form of a good opal globe, when a high degree of diffusion is obtained to eliminate glare and dense shadows, or any lamp fitting especially designed to direct lateral rays downwards. There are several good designs of these types, on the market, but a careful study should be made of all the requirements desired for the light before a choice is made.

A saving in capital cost can be effected by a careful scrutiny of the number and position of the points to be installed, and economy in running costs can be secured by reducing to a minimum the number of high-wattage lamps, and by the installation of meters in each department. The arrangement of the lighting points is a matter of individual opinion.

GAS

For general purposes gas is too expensive for continuous use, but where a supply is available it may, with advantage, be laid to the central kitchen, laundry, staff quarters, administration department, and to the villas in mental hospitals, for such use as gas fires in senior officers' offices and bedrooms, gas cooker in matron's flat, tea making in nurses' tea-pantries, and the gas incinerators in nurses' lavatories.

An appreciable percentage of the gas consumption is wasted in many hospitals from want of care on the part of the staff and, to prevent this, waste check meters should be fixed on the secondary gas services in addition to the main meters.

COMMUNICATIONS

It is very important in planning a hospital to consider the best means of communication between the administration department and other units of the hospital.

The telephone systems of the hospital consist of two services:

a internal communication;
b external communication.

Inter-communication between the various departments is effected by two methods:

a manually operated switchboard type;
b automatic type.

The selection of the particular type depends on the size of hospital. The selection of a manually operated switchboard type of internal telephone system requires the constant attention of a switchboard operator for 24 hours a day, and if an operator is required for the external telephone switchboard, the combination of the two duties may be possible. The automatic telephone system does not require an operator, as the caller dials as with the ordinary Post Office telephone. The manually operated switchboard is 15 to 20 per cent. cheaper to install than an automatic system, but before a decision is made local conditions should be investigated with the G.P.O.

In all hospitals, an external telephone switchboard, with extensions to the principal officers' offices and quarters, is a necessity. In addition call-boxes, to provide facilities for staff use and visitors, are of great service and permit of the switchboard operator giving her whole time to the hospital requirements.

Communication by light has been discussed in Chapters 18 and 36 under Call System.

Pneumatic-tube systems are basically for transportation purposes, but the speed with which they travel likewise permits their use for many communication purposes by written messages. In the hospital of two hundred beds or more there is a large amount of traffic involved in conveying records, reports, and messages between departments. Horizontal communication is ordinarily by foot travel, by messenger or by more highly paid personnel, and the vertical travel involved adds materially to the lift system.

The use of pneumatic-tube systems not only speeds up transport of reports, records, requisitions, business memoranda, etc., but effects a saving in labour which soon pays off the cost of the installation and its operation. In some hospitals it has been found a convenience for quick delivery of small items required in an emergency though this use is distinctly secondary to its use for transport of records, reports, etc.

The system consists of a vacuum, or compressor pump, a central despatching station, an outgoing and an incoming tube to each station and the station terminal. The system may be designed for various sized carriers, but the 4″ tube with a carrier 2¾″ inside diameter by 14″ long is preferred by hospitals. This carrier is large enough to receive the average patient's clinical record as well as smaller papers, records, and reports, and, if desired, small objects of other types—even to bottles up to 3 or 4 oz. prescription size. When intended to carry objects other than papers, the carriers may be felt-lined to prevent injury to the contents or they may be fitted with special kits to prevent injury by holding the object firmly in position. Carriers may be circular or elliptical in cross-section.

Stations are best recessed in the wall, sound proofed, and fitted with a door with a signal light to indicate receipt of a carrier. Despatching station is usually located convenient to station having the largest traffic, but as well isolated acoustically as possible. The pumps are somewhat noisy and must therefore be in a location relatively remote from patients areas, and so installed as to minimise noise and vibration.

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Cost

THIS BOOK is not concerned with cost. The problem is a complex one at the present juncture, and it is not known how post-war developments in construction will influence constructional costs.

In the first place, the range of possible variations in ward plans alone is considerable, and further developments arise as to whether the blocks be high or low buildings. Varying the shape of the ward blocks will lead to variations in the general plan, with consequential effection such items as corridors, staircases, and lifts. Thus, a particular layout of the ward unit alone may increase the cost of the ward blocks but enable savings to be made in other respects, and these savings may wholly or partially compensate for the higher cost of the ward blocks.

The Departmental Committee of the Ministry of Health in 1933 (previously referred to as The Report) investigated the cost of hospitals. The Committee's terms of reference specifically mentioned:

a the establishment and periodic revision of standards;
b modern methods of construction;
c the possibility of securing a reduction in present costs without impairing the efficiency of the buildings for the purposes for which they are designed.

Briefly and generally, the Committee's answers to these questions are:

a neither standards of building costs nor standardised building plans are feasible at present;
b while there are some useful alternatives to traditional methods, there is no new material or method of general application likely to lead to a large saving in cost, having regard to maintenance as well as capital cost. Generally speaking, it is not possible to reduce costs on any scale without impairing efficiency. Certain details are, however, capable of improvement.

The vexed question of horizontal versus vertical hospitals has been fully investigated. The Royal Institute of Chartered Surveyors took a typical group of ward units, and examined them arranged variously in from two to eight floors. With increase in height certain costs diminished, but others increased, the degree to which these neutralised one another depending on the size of the hospital and the plant arrangement. The

following table gives the relative costs of ward accommodation, taking into account corridors, staircases, and lifts:

NUMBER OF STOREYS	RELATIVE COST (INDEX FIGURE 100)
2	107
3	103
4	100
6	102
8	107

The general conclusion is that "the cost of construction is not affected by the number of storeys sufficiently to make it a determining factor . . . and that this decision should rest on other considerations." The Report did not give any information as to the influence of height on costs of hospital operation.

The London County Council as a result of investigation, submitted the following observations for interest.

a Architectural: the cost of building a hospital of a multi-storeyed type on a restricted site of up to three acres, would, other things being equal, be likely to be greater than that of a horizontal building on a more open site, because a vertical building must be of heavier construction and therefore more expensive. It will be apparent that to erect a hospital of a much more concentrated or compact type, it will be more difficult to plan satisfactorily in order to secure, among other things, the desirable light and air conditions. It would depend entirely upon the circumstances and requirements in each individual case, and on a very rough estimate the additional cost might be anything between 5 and 15 per cent. for a multi-storeyed building. On the other hand, maintenance costs would almost certainly be less in higher and more compact buildings.

b Engineering: the installation of engineering plant in a vertical building would be less costly than in a horizontal structure, owing to its greater compactness, which permits of the stacking of pipes and mechanical equipment; in a building where the various sections are distributed over a wider area, there would need to be a much increased length of piping and wiring. The engineering maintenance costs would be less in a multi-storeyed building. Further, in a vertical building a greater measure of value is obtained from the lift service, as it may be mentioned that lifts are used more in ratio to the number of storeys.

c Medical and administrative: from this aspect there are advantages in a vertical building, by reason of its greater compactness and the reduction to a minimum of the distances to be travelled by the staff in the conveyance of food and material, thereby facilitating supervision of patients and the various sections of the hospital. On the other hand, where the site is not restricted, there may be advantages in a combination of the two forms of planning in the

most suitable manner, the ward blocks being constructed on the lower principle. By such means, objections which might be made to either type of construction could probably be overcome and the advantages of both to a greater extent retained.

d Maintenance: there are no available data on which can be calculated the difference in the maintenance costs of vertical as compared with horizontal buildings, but owing to the greater advantages of a vertical building in compactness of planning, the running cost would tend to be definitely lower than in a building with its sections distributed over a wider area, a consideration which would specially apply to engineering costs.

To analyse—while for the general reasons already given, anything in the nature of comparative estimate of cost as between the two methods of treatment is practically impossible, and could only be definitely ascertained by consideration of actual cases, there appears to be reason to think that, other things being equal, the vertical rather than the horizontal development would tend in the direction of somewhat higher building costs, the reason being that a heavier type of construction would result from that arrangement. On the other hand, site works and the cost of maintaining vertically arranged buildings would probably be less than those of low height well spread out upon a larger area of ground. As regards engineering installations, it would appear that both in first cost and in maintenance the position would be generally favourable to the higher development upon relatively small sites, rather than the spread-out treatment. A similarly advantageous position, from the cost point of view, would seem to result as regards administration, staffing, and general services arrangements (including the supply of meals), in the vertically developed as against the spread out hospital—though it would, perhaps, not be possible to say that a corresponding advantage would be shown in respect of the successful fulfilment of what is the primary object of a hospital, i.e. the nursing and curative treatment of the patients.

The fallacious results of comparing hospital costs on the basis of "cost per bed," can only be used as such a basis in reference to patient accommodation only. In order to obtain a basis of comparison, a common practice is to divide the total cost of a hospital by the number of patient beds, and call the resulting figure "the cost per bed." There are, however, many fallacies associated with comparisons on this basis. In the first place, the cost even of similar hospitals does not vary directly with the number of beds, since the size and cost of certain units of the hospital do not rise and fall in proportion to this number. Secondly, the requirements of different hospitals vary considerably; one requires a large out-patient department, another does not; the class and type of work varies in different hospitals, and this is reflected in the numbers of staff required; one hospital may be staffed to a greater extent than another by non-resident personnel, and so forth. Thirdly, one hospital may have been built as a completed institution, while another has been planned with a view to early extension, and administrative accommodation provided on a scale suitable to many more than the initial number of patient

beds. These examples are not exhaustive, but they illustrate the difficulty of establishing any figure that could be regarded as normal "present cost."

Maintenance costs are regarded as being economically of greater importance than first cost. A hospital building lasts for very many years; interest on capital and sinking fund charges form only a comparatively small proportion of total annual expenditure.

The best available guide to the cost of equipping a hospital is the figure originally suggested by Dr. Goldwater in America some years ago, namely 10 per cent. of the cost of building. To this percentage something like 20 per cent. must be added to meet modern requirements.

So-called "loose equipment" i.e. equipment not attached to the building, furnishings, and furniture are not generally included in the building contract although their specifications and purchase may at times be delegated to the architect.

Conclusion

MANY OF THE points mentioned in the preceding Chapters will appear very elementary and obvious to architects and administrators, but they have been deliberately included, for they tend to be forgotten.

It is again urged that the architect and the administrator collaborate from the very inception of the scheme, and that when the building operations commence, a responsible medical man should also be more or less continually on the site—in this way, innumerable deficiencies and mistakes can be rectified. It is also an advantage if the matron be consulted as early as possible, because many minor adjustments appertaining to her own sphere—which is a considerable one—may then be made which at a later date would be impossible. There are so many points where these administrators can usefully assist, apart from the relationship of one department to another and the disposition of the rooms of the various units. Such minor points as the disposition of the cleaners' sinks throughout the hospital, the size of shelves, or the relationship of the outlet of the potato-peeler to the sink—which make for easy working—are matters where the experience of these officers is invaluable.

It is only by such collaboration that all the practical problems involved can be successfully solved, and the result is a hospital at least structurally suitable to be an efficient unit in the fight against disease. The hospital structure is a tool for the care of the sick. The more closely it can be fitted to its purpose the more satisfactory will be its performance, the more economical its operation, and the greater its value to the community as a whole.

Finally, the question of architectural interest and beauty is now recognised to be just as important for hospitals as it is for banks, churches, and private residences, and it is encouraging to find that this side is now so much more considered than it used to be in the last century. There is a determined effort to make the buildings attractive both externally and internally, and the architects in Great Britain have begun to work out their own ideas in this respect.

Bibliography

THIS BOOK is compiled from all sources contributing technical information on hospital design and construction. These sources are principally the many research bodies, official and individual experts, and technical journals and other publications published in this and other countries. Much of the best material is scattered about in books not specifically dealing with hospitals, the mere enumeration of which would occupy many pages.

These books, journals etc., are available for reference or loan by members, or by special arrangement, from the R.I.B.A. Library, 66, Portland Place, London, W.1 and the B.M.A. Library, South Tavistock Square, London, W.C.1. Most of these books are in English, but there are many important books in foreign languages, particularly French and German.

Special attention should be paid to the memoranda issued by the Central Bureau of Hospital Information (52 Green Street, London, W.1) which contain much valuable information on hospital equipment.

The Building Centre, 9 Conduit Street, London, W.1, always has on view many of the best and latest items of hospital equipment and building materials. Its object is to provide hospital authorities, architects, and all persons engaged in hospital work of any kind, with a comprehensive advisory service as regards planning, materials and equipment. The hospital section contains a model operating theatre and ward units, with extensive exhibits of medical equipment, electro-medical fittings, sanitary and electric light fittings, together with all appropriate furnishings. A most important unit of this section is the permanent library of hospital plans which are being collected from architects all over the world, and which are available for inspection.

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